Aviation Week & Space Technology

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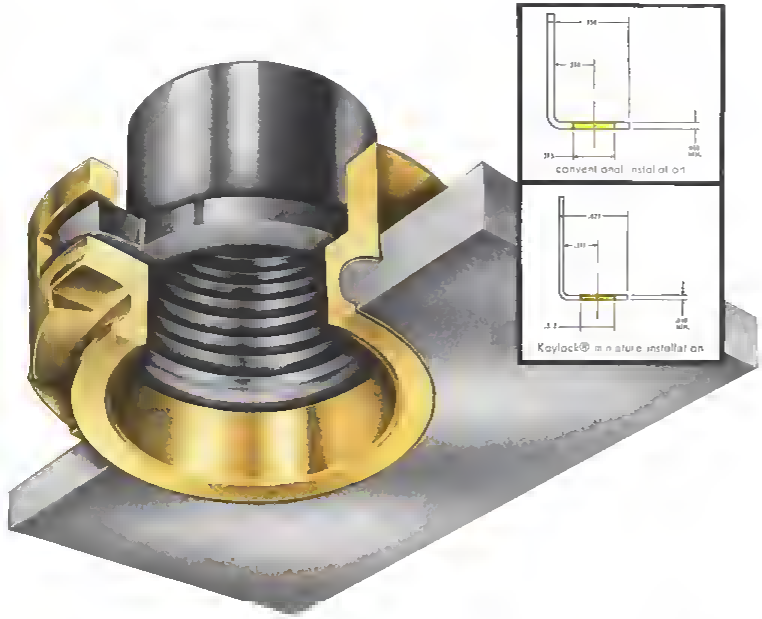
April 23, 1962

Glenn Pilot Report On Space Flight

Titan 2 Launch



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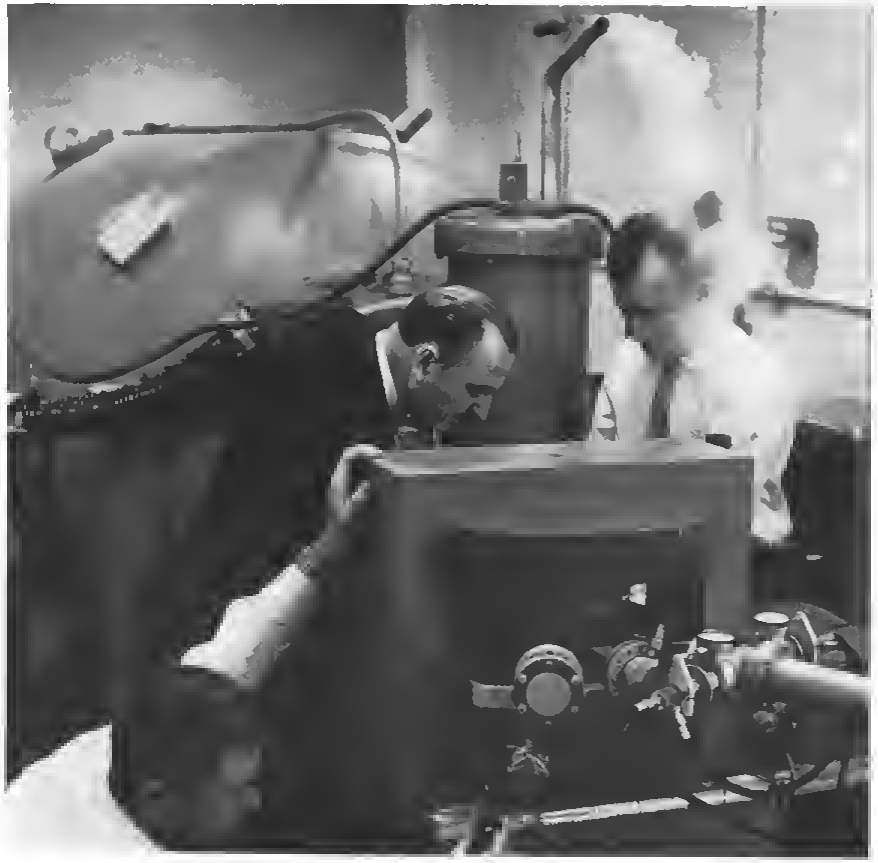

AEROSPACE CALENDAR

Apr 30-May 1—Annual Meeting, National Aeronautical Services Assn., Shoreham Hotel, Washington, D.C.

Apr 30-May 2—Meeting on Manned Space Flight, Institute of the Aerospace Sciences, Hotel Chase, St. Louis, Mo.

Apr 30-May 3—Design Engineering Show & Conference, McCormick Place, Chicago.

May 1-3—Spring Joint Computer Conference, Fairmont Hotel, San Francisco.

May 1-3—Biologistics for Space Systems Symposium, Biltmore Hotel, Dayton, Ohio. Sponsor: Aerospace Medical Research Laboratories, Aeronautical Systems Division, AFSC, Wright-Patterson AFB.

May 2-3—Sixth Navy Science Symposium, U.S. Naval Radiological Defense Laboratory, San Francisco, Calif. Sponsor: Office of Naval Research.

May 2-4—18th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D.C.

May 2-11—International Space Research and Technology Exhibition, London, England. Sponsor: British Interplanetary Society.

May 3-4—First International Congress on Human Factors in Electronics, IRE, Lafayette Hotel, Long Beach, Calif.

May 5—First Tidewater Area U.S. Naval Test Pilot School Reunion, U.S. Naval Air Station, Oceana, Va.

May 7—Civil Air Patrol's 20th Anniversary Congressional Banquet, Statler Hilton Hotel, Washington, D.C.

May 7-9—Materials & Processing for Space

(Continued on page 7)

AVIATION WEEK and Space Technology

April 23, 1962

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AEROSPACE CALENDAR

(Continued from page 5)

Environments Symposium Society of Aerospace Material and Process Engineers Hotel Statler St Louis, Mo

May 7-11—Annual Conference, Society of Photographic Scientists and Engineers, Somerset Hotel, Boston, Mass Co-sponsor AF Cambridge Research Laboratories

May 7-11—1962 Tool Exposition & Engineering Conference Public Auditorium Cleveland Ohio

May 8—Management Conference on Marketing in the Defense Industries Boston College Chestnut Hill Mass Sponsors American Marketing Assn Bureau of Business Research Boston College

May 8-10—12th Annual Electronics Components Conference Marriott Twin Bridges Motor Hotel Washington, D C

May 8-10—Second National Conference on Peaceful Uses of Space Seattle Wash Sponsor National Aeronautics and Space Administration

May 11-12—Western Regional Convention Air Traffic Control Assn Senator Hotel Sacramento Calif Fly-In Mather AFB

May 14-16—National Aerospace Electronics Conference, Institute of Radio Engineers Biltmore Hotel, Dayton, Ohio

May 14-16—Joint Technical Society-Department of Defense Symposium on Thermionic Power Conversion, Antlers Hotel, Colorado Springs, Colo

May 14-17—21st Annual National Conference Society of Aeronautical Weight Engineers Benjamin Franklin Hotel Seattle

May 16-18—Spring Meeting, Society for Experimental Stress Analysis Sheraton Dilas Hotel Dallas Tex

May 17-18—Spring Meeting Jet Testing Assn Allison Division General Motors Corp Indianapolis Ind

May 20-24—Annual Conference American Assn of Airport Executives Ambassador Hotel Los Angeles Calif

May 20-26—Annual Meeting Aviation/Space Writers Assn Mark Hopkins Hotel San Francisco Calif

May 21-22—Annual Meeting and Aviation Fire Safety Seminar National Fire Protection Assn Sheraton Hotel Philadelphia Pa

May 21-25—Second Annual Air Transportation Conference New York University Washington Square Center New York N Y Co-sponsor International Transport Institute

May 21-25—Eighth Aerospace Instrumentation Symposium and National Telemetering Conference Sheraton Park Hotel Washington D C

May 22-24—Conference on Self-Organizing Systems Museum of Science and Industry Chicago Ill Spoosors Office of Naval Research Armour Research Foundation

May 22-24—National Microwave Theory & Techniques Symposium Institute of Radio Engineers Boulder Colo

May 24-26—Seventh Region Conference on Space Communications Institute of Radio Engineers Seattle Wash

May 30-June 2—14th Annual Wright Memorial Glider Meet For information Soaring Society of Dayton Inc Fat Hills

(Continued on page 9)

NEW RADAR FOR OLD

(Or: Mitigating senility by modification)

With due allowance for the relaxing accoutrements of the local pub, we came away from the latest conclave of the RF Systems wing of the Budd Electronics Chowder and Marching Society with the conclusion that engineers wax philosophical more often than they're given credit for doing.

This admittedly non-earthshaking realization evolved as the assembled cohorts discussed how the nation's radar can best be kept up to date with an increasingly sophisticated electromagnetic environment. If we attempt to replace each existing set with an entire new one, a number of sets will be badly outdated before we get around to them. And by the time the latter sets are replaced, we'll be faced with the advancing senility of those replaced earlier.

The evening was still young when it was agreed that the building of new sets should be paralleled by the modification of existing ones. Modification is faster and less costly . . . puts new techniques to work sooner . . . and lets us update our capabilities on a rotating basis.

Now, *how* to modify—that's the question that fueled the collected minds 'til the wee small hours. For one thing, we have to minimize the effects of various types of jamming—barrage, picket, chaff, etc. This we're working on under a current contract.

Another constant problem is the number of spurious signals*. The need to minimize them is reflected in present constant false alarm rate system (CFAR) projects, the subject of which perceptibly quickened the pace of the discussion. It resolved into an exchange of ideas on how to produce a reliable, slick-operating video integrator.

Meanwhile, a splinter group had launched into the subject of frequency agility and the ways we might be able to transmit at random at any frequency within a broad band. The mere mention of transmitting triggered the data processing contingent on one of their pet topics—the telephone line transmission of radar data in digital form from unattended gap filler sites to prime sites. This was in turn the signal for the fellows working on the gap filler contract to enlighten the gathering (under protest) on how they're achieving reliability . . . and to receive justified though jocular jibes on their unbecoming lack of modesty.

You would have enjoyed being there . . . and we'll be glad to have you join us as an honorary member at future meetings. Your membership will bring you a Chowder and Marching Society button and card, and sundry other benefits as well. Apply on letterhead, please.

Should you prefer a more organized discussion of your specific problems, you'll find our staff experienced for over 20 years in many varied aspects of radar research, development and production . . . and adept at coming up with unstereotyped ideas on designing new radar sets and modifying existing ones. Let's get together. RF Systems Dept., Budd Electronics, 43-22 Queens St., Long Island City 1, New York.

*Early radar engineering term. Meaning "I thought I had it made until that blankety-blank flock of mallards showed up!"

AEROSPACE CALENDAR

(Continued from page 7)

Branch, P. O. Box 581, Dayton 19, Ohio.

June 4-7—1962 Nuclear Congress, Statler Hilton Hotel, New York, N. Y.

June 6-7—Symposium on Standards for Filament Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md.

June 6-8—Eighth Annual Radar Symposium (classified secret), Institute of Science and Technology's Radar Laboratory, University of Michigan, Ann Arbor.

June 8-9—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 13-15—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.

June 18-Aug. 10—Advanced Subject Matter Institute on Nuclear Rocket Propulsion, University of Florida, Gainesville, Fla. Sponsor, National Science Foundation.

June 19-21—39th Meeting, Aviation Distributors and Manufacturers Assn., Ambassador Hotel, Los Angeles.

June 19-22—Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles, Calif.

June 20-22—Annual Convention, Airline Ground Transportation Assn., Barclay Hotel, New York, N. Y.

June 25-27—Sixth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 25-30—Symposium on Electromagnetic Theory & Antennas, Copenhagen, Denmark. Sponsors, Technical University of Denmark, International Scientific Radio Union.

June 26-28—Aviation Conference, American Society of Mechanical Engineers, University of Maryland, College Park, Md.

June 27-28—Ninth Annual Symposium on Computers and Data Processing, by the University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park.

June 27-29—Joint Automatic Control Conference, Institute of Radio Engineers, New York University, New York, N. Y.

June 28-29—Fourth National Symposium on Radio Frequency Interference, Institute of Radio Engineers, Town House, San Francisco, Calif.

July 17-19—Lunar Missions Meeting, American Rocket Society, Pick Carter and Statler Hilton Hotels, Cleveland, Ohio.

Aug. 10-11—Future of Manned Vehicles in Air and Space, Institute of the Aerospace Sciences, Olympic Hotel, Seattle, Wash.

Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.

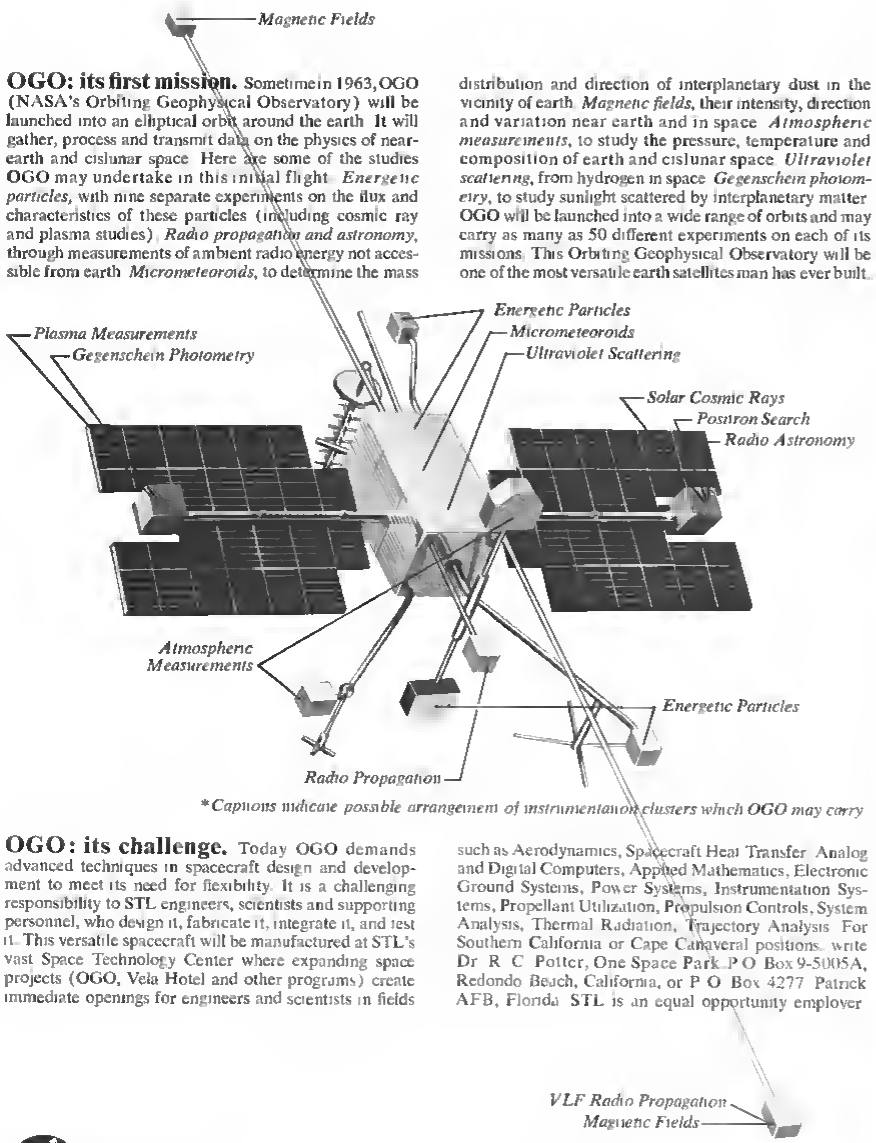
Aug. 21-Sept. 17—14th Session International Civil Aviation Organization Assembly, Rome, Italy.

Aug. 27-Sept. 1—Third International Congress, International Council of the Aeronautical Sciences, New Congress Hall, Stockholm, Sweden.

Sept. 3-9—1962 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dublin, Ireland.

Sept. 18-23—16th National Convention & Aerospace Panorama, Air Force Assn., Las Vegas, Nev.



OGO: its first mission. Sometime in 1963, OGO (NASA's Orbiting Geophysical Observatory) will be launched into an elliptical orbit around the earth. It will gather, process and transmit data on the physics of near-earth and cislunar space. Here are some of the studies OGO may undertake in this initial flight. *Energetic particles*, with nine separate experiments on the flux and characteristics of these particles (including cosmic ray and plasma studies). *Radio propagation and astronomy*, through measurements of ambient radio energy not accessible from earth. *Micrometeoroids*, to determine the mass distribution and direction of interplanetary dust in the vicinity of earth. *Magnetic fields*, their intensity, direction and variation near earth and in space. *Atmospheric measurements*, to study the pressure, temperature and composition of earth and cislunar space. *Ultraviolet scattering*, from hydrogen in space. *Gegenschein photometry*, to study sunlight scattered by interplanetary matter. OGO will be launched into a wide range of orbits and may carry as many as 50 different experiments on each of its missions. This Orbiting Geophysical Observatory will be one of the most versatile earth satellites man has ever built.

*Captions indicate possible arrangement of instrumentation clusters which OGO may carry

OGO: its challenge. Today OGO demands advanced techniques in spacecraft design and development to meet its need for flexibility. It is a challenging responsibility to STL engineers, scientists and supporting personnel, who design it, fabricate it, integrate it, and test it. This versatile spacecraft will be manufactured at STL's vast Space Technology Center where expanding space projects (OGO, Vela Hotel and other programs) create immediate openings for engineers and scientists in fields such as Aerodynamics, Spacecraft Heat Transfer, Analog and Digital Computers, Applied Mathematics, Electronic Ground Systems, Power Systems, Instrumentation Systems, Propellant Utilization, Propulsion Controls, System Analysis, Thermal Radiation, Trajectory Analysis. For Southern California or Cape Canaveral positions, write Dr. R. C. Potter, One Space Park, P.O. Box 9-5005A, Redondo Beach, California, or P.O. Box 4277, Patrick AFB, Florida. STL is an equal opportunity employer.

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EDITORIAL

One Horse and One Rabbit 17

COVER— First Martin/USAF Titan 2 launch from Cape Canaveral, Fla., was photographed at lift-off by a remote camera. Shock patterns are clearly visible in the missile's relatively smokeless flame due to missile's hypergolic propellant: half and half mixture of dimethylhydrazine and hydrazine, plus nitrogen tetroxide (AW Sept. 25, p. 139). Missile made a successful 5,000 mi. flight down the Atlantic Missile Range Mar. 16. Titan 2, in addition to being emplaced at three ICBM bases, is expected to be the booster stage of a number of planned space shots. What appear to be black marks on vehicle above star insignia are open spaces to allow second stage engine exhaust to escape. Second stage engine is ignited before stages separate. (See page 78 for other details.)

PICTURE CREDITS

Cover—R. J. Brehaman, USAF/BCA; 23—USAF; 25—Parrock; 26, 27—Aviation Week; 28—NASA; 29—Bristol S. Siddeley; 30—Dornier-Flenz; 41—Vickers; 43—Federal Aviation Agency; 49—Lockheed; 55—NASA; 57—Douglas; 59—Boeing; 63, 65—GE; 69, 71—Astrodata; 75, 77—Cranfield College of Aeronautics; 78, 79—USAF; 81, 101—Boeing; 89—Cornell Aeronautical Laboratory; 90—GE; 93—Avro; 97—(left) United ElectroDynamics, Inc. (right)—Aviation Week; 98—Westinghouse; 102, 103—Aviation Week; 103 (bottom)—Potez; 105—Werkfoto; 107—Peggie Dangler.

87,646 copies of this issue printed

EDITORIAL

One Horse and One Rabbit

The current U S and USSR maneuverings toward some sort of international cooperation remind us of the recipe for rabbit sausage used by a wurstmacher in our native Milwaukee When the customers complained that his "rabbit sausage' tasted more like horsemeat he defended his product on the ground that the recipe was "50 50—one horse and one rabbit"

In all of the U S -USSR negotiations of the past seven years this "one horse and one rabbit" approach has characterized the Soviets' approach to parity Unfortunately, in most cases this formula has also measured the results—a horse for the Soviets and a rabbit for us

At this stage of the game the American people and their leaders should be used to the facility with which the Soviets can change their tactics to meet changing situations without ever altering their ultimate goal of establishing worldwide Russian imperialism in the name of Communism

We have seen, during several cycles as the world temper has changed and Soviet plans have gone awry, the alternate smiling faces of kindly Uncle Nikita who likes to exchange notes on grandchildren and corn-raising methods and the shoe-pounding bully threatening to incinerate any people who do not willingly accept the yoke of Soviet slavery

Soviet Professions

Thus it is interesting to speculate on why the Soviets now profess a serious interest in sharing space data and facilities with the U S after scornfully spurning the suggestion since Sputnik 1 The first and most obvious conclusion that could be drawn is that the Soviets now feel they have more to gain than lose by a skillfully negotiated 'one horse, one rabbit' type agreement in space technology

In the days from the orbiting of Sputnik 1 to the 18-orbit manned space flight of Gherman Titov, the Soviets justifiably felt that they led the world in space technology and were not the least bit interested in any international sharing of their data It was painfully embarrassing to their space scientists to participate in international technical meetings with the tight security clamps on their papers that made them look Lilliputians in comparison with the scientific detail presented by space technologists of other nationalities The Communist bloc countries pointedly refused to participate in the international workshop on use of weather satellites sponsored by the U S last year The Communist technical press has been full of sneering, derisive analyses of the U S space program

Why do the Soviets now think they might benefit from an international exchange of space technology data in the areas specified by President Kennedy and Mr Khrushchev? One reason certainly might be the accelerated pace and determination of the U S space program since President Kennedy's decision to put this country squarely in the space race with the USSR—with the moon as a clearly defined goal

It has long been our contention that the Soviets do not have the resources to compete successfully with this country in any of the major areas of modern technology where both countries are equally determined to achieve superiority It has been the differential between U S apathy and Soviet determination that created most of the disparities that appeared in missile and space technology during the mid 1950s

Challenge Accepted

Now that President Kennedy has flung down the gauntlet to the USSR in the space race to the moon and the Congress has exhibited willingness to back this venture with adequate appropriations, it may well be that the Soviets are recognizing that they cannot stay in contention for the long pull to the moon and are looking for ways to blunt the effects of these future U S achievements If these U S achievements come only after an international space agreement has been formally concluded with the USSR, it will be easy for the Soviet propaganda machine to bill them to the world as evidence that American 'pupils' have learned well from their Soviet scientist 'teachers."

It may also be that the Soviet space program is suffering from a lack of sufficient scope to produce the broad base of scientific data required as a foundation for future effort A simple tap into the U S programs would soon eliminate this deficiency

All of these hypotheses could of course, easily be dismissed as unrealistic cynicism were it not for the Soviet performances on the nuclear test ban Berlin arms control and all of the other major issues along the U S-USSR interface of the past five years In approaching any serious efforts to explore an interchange agreement in space technology with the Soviets, we should be extremely cautious in making any commitments that equate parity with the Milwaukee sausage maker's formula of "one horse and one rabbit" —Robert Hotz

WHO'S WHERE

In the Front Office

Willis M Hawkins, vice president engineering Lockheed Aircraft Corp Burbank Calif, succeeding **Hall L Hibbard** who continues as senior vice president **Reginald R Kearton** a corporate vice president succeeds Mr Hawkins as general manager of Lockheed Missiles and Space Co's Space Systems Division

Dan A Kimball, a director of Hycon Mfg Co, Monrovia, Calif Mr Kimball is president of Aerojet General Corp and chairman of the Aerospace Industries Assn

Alan G Binnie R M Mock and **A Durham** directors of Astek Instrument Corp., Armonk, N Y Mr Binnie is president of Cap Instrument Corp and Messrs Mock and Durham are executive committee chairman and treasurer-comptroller respectively of Lear Inc

Claude M Hathaway, former president of Hathaway Instrument Co has announced the formation of Western Electrodynamics Co Colorado Springs Colo Mr Hathaway will direct the research and development of the company

Russell E Bauer vice president Electronic and Servo Systems Group Ex-Cell-O Corp Detroit Mich

Elmer J Stone, chief counsel Douglas Aircraft Co's Missile and Space Systems Division, Santa Monica Calif

Dr Louis Malter a vice president, Varian Associates Palo Alto Calif

M Robert Rowe manager General Electric Co's Commercial Engine Operation Evendale Ohio succeeding **Neil Burgess**

Arthur E Raymond has been appointed a special consultant to **James E Webb** administrator of the National Aeronautics and Space Administration

Victor J Pollock financial vice president and treasurer Leach Corp Compton Calif

Lionel H Nanna head Program and Public Information Operation of General Electric Co's Defense Programs Operation with headquarters in Syracuse N Y

Gordon M Bain, assistant administrator for appraisal Federal Aviation Agency Washington D C

Honors and Elections

Brig Gen Don Flickinger (USAF ret) has been installed as president of the Aerospace Medical Assn **Dr Charles I Barron,** medical director of Lockheed California Co named president-elect of the association

Dr Ross A McFarland, of Harvard University has received the Aerospace Medical Assn's Walter Boothby Award, which recognizes outstanding research directed at the promotion of health and prevention of disease in professional airline pilots

National Aeronautics and Space Administration has presented Invention Awards to the following NASA engineers for inventions which have contributed to the advancement of aeronautical and space science and technology **Henry J E Reid, Jr** and **H Douglas Garner** of Langley Research Center and **James S Albus,** of the Goddard Space Flight Center

(Continued on page 109)

INDUSTRY OBSERVER

► Significant signature data on Russian ballistic-missile re-entry vehicles was obtained by U S ships and aircraft working under Project Big Arm during last year's Soviet ICBM tests in the Pacific

► **Second United Technology Corp. P-1 225,000-lb. thrust solid-propellant rocket was to be fired last week for a duration of about 130 sec to determine effects of long-duration burning on rocket components Hypergolic ignition technique and thrust vector control using nitrogen tetroxide were to be included in the demonstration, which was under research contract with Edwards AFB 6593rd Test Group (Development)**

► Proposals for mobile medium range ballistic missile propulsion system are due Mar 18 at Air Force Systems Command's Ballistic Systems Division Briefing for potential bidders was held last week at BSD

► **Nuclear explosion effects on loading and response characteristics of flight vehicle and missile structures will be studied under contracts to be sponsored by Air Force Systems Command's Aeronautical Systems Division ASD also will sponsor separate studies of structural vulnerability to high-intensity, short-duration impact and thermal loadings associated with nuclear explosions**

► Evaluation of industry proposals by improved methods is the aim of a study being performed for AFSC's Ballistic Systems Division by Corporation for Economic and Industrial Research

► **Sea launchings of a variety of unguided probe rockets in a class from Arcas to Scout and X-17 sizes will be studied in programs to be sponsored by Naval Air Station, Pt Mugu, Calif Studies will concentrate on erecting and launching techniques**

► Hawker P 1127 Britain's prototype VTOL fighter, and its Bristol Siddeley BS 53 vectorable-thrust powerplant, received extensive technical support during design phases from National Aeronautics and Space Administration NASA work included dynamic model tests and power-effects research

► **Comparisons of orbital military space weapons—manned, unmanned, offensive and defensive—will be made in a planning study to begin soon Air Force Space Systems Division will conduct the study, aimed at examining tradeoffs of one system against another.**

► British Blackburn Buccaneer Mk 2 strike aircraft, in production for the Royal Navy will be fitted with two 250 gal slipper tanks Tanks have been built for flight test they are hung outboard of the engine intakes and inboard of the wing fold Project marks renewal of interest in auxiliary tanks for the Buccaneer flight tests were made two years ago with wooden mockups, but the program was not then continued

► **New concepts or substantial improvements in electromagnetic and electrostatic space power generators to produce efficiencies approaching 99% at power levels above 300 kilowatts are being sought by AFSC's Aeronautical Systems Division**

► Snap 8 nuclear package would be evaluated as an auxiliary power source in a flight test program under consideration by Lewis Research Center, National Aeronautics and Space Administration The Center may issue a request for proposals soon

► **Industry proposals for a $250,000 development program in optical maser welding are being evaluated by AFSC's Aeronautical Systems Division Bidders included a team formed by AiResearch and Quantatron as well as Hamilton Standard, Hughes, and Technical Research Group**

► Russian scientists now believe it may be possible to develop special monitoring equipment to record genetic changes in bacteria during space flight and telemeter the data to earth

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Washington Roundup

Space Secrecy Muddle

Confusion and dismay have followed the new Defense Department directive restricting information on military space activities (AW Apr. 16, p. 35). Military working level personnel and industry engineers and scientists see in end to any real exchange of technical information. One stringent requirement of the still secret document is that every recipient of classified information have a "need to know." This could wipe out classified sessions at technical societies meetings. Another provision prohibits identification of any individual, civilian or military, with any specific project.

Industry is just beginning to feel the punch but the directive already is leading to elimination from proposed advertisements and press releases of names of space vehicle projects and illustrations and text that have been cleared and printed many times before.

Rep. John Moss, chairman of the House Government Information Subcommittee, said he is "mighty concerned" about the directive. His staff has begun to look into the reasons for it and its implications. Rep. Moss said he is particularly concerned over whether the new order will interfere with the flow of information between NASA and the Defense Department, and whether Defense now may pursue space projects independently, possibly duplicating NASA's work.

Teague's Security Views

Space secrecy has found a friend in Rep. Olin Teague, second ranking Democrat on the House space committee, who is concerned over the military implications of space. He introduced a resolution that would express congressional intent to have the U.S. reveal nothing more to other nations about its space programs—civilian or military—until Russia actively participates in an armaments inspection system and discloses what it has learned through its space efforts. He said the two Soviet orbital flights, the tests of nuclear weapons and new long range missiles and last summer's Tushino air show "are the cause for serious alarm." When U.S.-USSR space cooperation talks began recently, Rep. Teague said it was "utter stupidity" for the U.S. to expect to gain as much as Russia would. He also questioned the wisdom of putting a scientist—Dr. Hugh Dryden, NASA deputy administrator—against Russian artillery general Anatoli A. Blagonravov (AW Mar. 26, p. 23).

Operations in South Vietnam have lent impetus to a study now being made by the staff of the Joint Chiefs of Staff regarding a relatively slow, propeller-driven troop support aircraft for jungle work (AW Mar. 26, p. 13). Meanwhile, the U.S. has added a 400-man Marine helicopter unit, using 16 H-34s, to its forces in South Vietnam.

Hurdle for Comsat

Formidable opposition to a bill authorizing a communications satellite corporation that would be part publicly owned and part privately owned by communications carriers is now expected on the Senate floor. A group led by Sen. Estes Kefauver and generally favoring government ownership claims 20 supporters and the ability to delay action for three weeks—which would in effect kill the bill. Senate commerce committee will complete its hearing this week. Acting Chairman John Pastore plans some amendments to further preclude domination of the corporation by the American Telephone & Telegraph Co.

Kennedy Administration, fresh from its victory in the steel wage and price situation, "will attempt to describe the public interest" to aerospace companies and the machinists and auto workers' unions, which are approaching a major round of labor negotiations, the President said last week. He said the government does not have the power "to enforce any collective bargaining agreement," but the public interest involved "in a program so important to the national security" will be pointed out to both sides.

Solid Rocket Delay

Intense political maneuvering over the development of 120-in.-dia. solid rockets for the Titan 3 continued late last week, with a possibility that the issue would be settled at the end of the week. One probability that remained was for a new Phase 1 to be introduced, during which two contractors would carry preliminary development to the point of firing one rocket each. Defense Department favored such a phase, chiefly to force a restudy of costs. Air Force was opposed on the basis that enough studies have been made. It wanted a single contractor with strong systems management experience. California, Connecticut, Utah and Idaho are interested in the decision and the jockeying among congressmen has been as lively as that among the companies.

Image of the next Russian space man: "Cosmonaut No. 3 . . . is a most charming person,' according to the news agency Tass. 'He sees good in everyone, he is loved by everybody and treats everyone with kindness and respect.'"

Note to Pentagon planners—skip the technical paper scheduled for delivery at the American Physical Society convention in Washington this week and titled "Scattering of Electromagnetic Radiation from Fuzzy Cloudy Crystal Balls." It concerns nuclear theory.

—Washington Staff

NASA Contracts to Lay Stress on Quality

Hardware reliability is considered vital; $3-billion contracting program also will emphasize incentives.

By Edward H. Kolcum

Washington—Bold new procurement techniques aimed at increasing the quality of work and introducing incentives into the rapidly expanding space program—which may exceed $3 billion in contracts in Fiscal 1963—are being developed by National Aeronautics and Space Administration.

Objectives are to eliminate technical problems on the production line rather than face the prospect of increasingly expensive failures in space, and to place a premium on over-all contractor performance.

Legal basis for NASA's procurement is the same as the Defense Department's, but the space agency is introducing some variations in the degree of quality control it demands because each major item in the space program is becoming more expensive. The military services entered into missile development under heavy pressure of time and performance, with the number of development launches virtually unlimited. NASA faces the combined demands of near-perfect reliability—particularly in manned flights—and a minimum number of development launches because of the high cost per launch.

Apollo Reliability

Reliability in the Apollo manned lunar landing mission is emphasized by the fact that the three-man crew must conduct a countdown and launch by themselves for the return from the moon to earth, whereas a launching from Cape Canaveral requires several hundred men.

Cost of even a few launch failures in the Nova vehicle program would become prohibitive, and NASA would undoubtedly lose much of its current public and congressional support. Cost per launch of Nova is estimated at $80-$100 million, and the agency recognizes that each launch must meet its objectives for practical as well as scientific reasons.

Quality Requirements

The new quality assurance program becomes formal in about a week and will be an integral part of NASA's space procurement actions in both prime and subcontracts dealing with hardware. Aerospace companies bidding on NASA jobs will be required to define their own quality control programs in their proposals and to submit monthly quality status reports.

The agency is originating what is considered a bold experiment in incentives for research and development work. The initial step is an experiment with overhead costs, but this could spread to direct costs and performance by systems contractors.

In the plan under development, the contractor and NASA will negotiate on such overhead costs as bidding, bonding, labor relations and other business expenses which are not related to hardware production. If the contractor can reduce these costs below the negotiated figure, his fee could be increased to the statutory 15% maximum, rather than the 6.5% fee which is the NASA average.

The agency intends to experiment with this program briefly and, if it is successful, to extend it to some of its major programs such as Scout and Gemini, for which cost histories exist.

Incentive Difficulties

Difficulty NASA faces with incentives is defining targets for hardware that has never been made before. The requirement for a formal quality assurance specification is much more pressing because of the nature of the agency's business—it must buy a small number of a wide variety of components, all of which must be highly reliable and many of which must be qualified for manned flight.

Preliminary versions of NASA's quality requirements are included in the Apollo contract with North American and the Gemini contract with McDonnell Aircraft.

George Vecchietti, assistant director of NASA's Procurement and Supply Division, told AVIATION WEEK the new quality control specifications place more stringent requirements on contractors because the ultimate objective is perfection.

The specifications, known as the NPC 200 series, consist of these provisions:

- **Quality** program for space systems contractors, which details requirements for major contractors with design, development and fabrication responsibilities. They will be required to write the quality program plan for the project as it is developed, and to define design control, drawing and specification review procedures, qualification tests, controls for fabrication and processes, and to relate their quality program to reliability.

Howard M. Weiss, chief of NASA Quality Assurance Programs, said this specification, designated 200-2, will provide more product verification than has been possible previously, primarily because of the degree of detail that must be planned and documented to assure quality.

- **Inspection system** for suppliers of space materials, parts, components and services developed mainly for contractors without design or development responsibilities. Contractors operating under this specification, called 200-3, may be required to prepare a written inspection plan.

Both major contractors and suppliers, Weiss said, will be required to detail troubles and malfunctions and to document corrective action they have taken.

- **Quality assurance** for inspection agencies, designated 200-1, is designed to establish requirements for NASA and Defense agencies which will manage the quality assurance program. Generally, their responsibilities are to develop quality assurance and inspection plans, monitor the quality assurance system among contractors and prepare monthly quality status reports.

These procedures will give NASA for the first time a direct formal control over the quality of the hardware it buys. There are no punitive measures for noncompliance and non-performance, rather Weiss feels the program will be an incentive since the agency will accumulate histories which will be used in future source selections.

Because NASA's procurement system is fully de-centralized, the agency's field centers will manage the quality control requirements as part of their over-all contract supervision. Continuous assessment of product quality will be made by visits to plants, quality surveys and review of quality data, regular and "trouble" reports, investigations and data analyses.

The contractor's role in this re-emphasis of quality, in addition to making his quality program plan a part of his bid proposal, includes documenting his test and inspection procedures, component and end-item test and inspection procedures, end-item test plan, and quality status list—a complete survey of each part that goes into a system.

Quality assurance for major contractors operating under NPC 200-2 includes activities in feasibility studies, design and development, purchase, materials, parts, components, system assembly, final checkout and space operations. Suppliers under NPC 200-3 are covered in quality assurance for materials, parts and components.

Weiss said major subcontractors and subcontractors with complex assembly design responsibilities will operate under 200-2, and some contracts will include portions of both 200-2 and 200-3.

Vecchietti said NASA is surveying its field installations to find areas where incentives are practicable and useable.

Although NASA's average fee in cost plus fixed fee contracts is about 6.5%, if a contract involves "breaking" the state of the art, it can go as high as 8 or 9%. If it involves a simple inspection of an off-the-shelf item, it can go as low as 0.5%.

Decentralized Procurement

The agency's procurement actions are decentralized because a huge number—well over 100,000—separate contracts will be written in Fiscal 1962. All research and development contracts over $1 million require the action of a source evaluation board, usually five to seven technical and administrative officials headed by the chief of the program involved.

On contracts of $1-5 million, the source evaluation board is convened at the field installation where the project is to be managed, and the center director can make a final selection. On contracts over $5 million, final selection is made by James E. Webb, NASA administrator, usually after consulting with Dr. Hugh L. Dryden, his deputy, and Dr. Robert C. Seamans, Jr., associate administrator.

NASA has evolved a routine procedure for contracts starting with a request for a procurement plan by the affected program office after a program has been approved. The procurement plan includes the solicitation period, bidder's briefing and type of contract to be used. While the plan is being drawn, the source evaluation board is nominated by the program chief and is appointed on Seamans' approval.

The board establishes general criteria, such as the reliability and performance desired and the problems involved. It then assigns "weights" or values to each criteria heading. At the bidders' conference, prospective bidders are told what is desired but are not told specific criteria weights.

When proposals are received, the board is divided into technical and business committees, which apply the weight criteria to the written proposals, check company contracting histories with Defense Department and government auditors and write their findings.

The source evaluation board never recommends a contractor. Instead, it makes its findings in the form of a report. Early in NASA's history, the agency did not release the recommendation of the Project Mercury source evaluation board because of its interpretation of executive privilege. As a result of the furor that resulted in Congress, source evaluation reports now are in the form of findings, which can be released to Congress rather than executive recommendations, which can not.

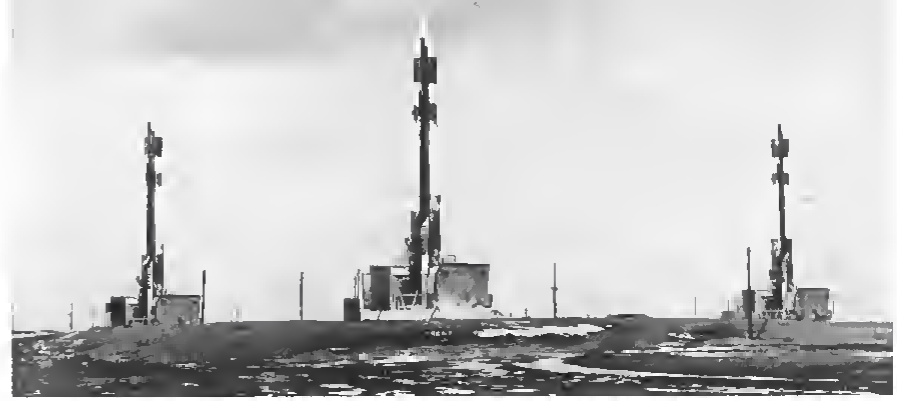
Bundestag Halts German JetStar Order

Bonn—West German Bundestag, giving the over-all Fiscal 1962 defense budget a close survey in an effort to combat rising national costs, has denied requested air force funds for the purchase of 12 Lockheed JetStar executive transports planned for use as advanced navigation trainers. Air force, however, is expected to get authorization to order two general-purpose JetStars for VIP and high-priority transport.

Air force had planned to use the 12 JetStars to train future pilots of the Mach 2 Lockheed F-104G interceptor in the use of the aircraft's North American Aviation NASSAR all weather fire control system. Training now reportedly will be conducted in DC-3 type aircraft modified for this purpose by Hamburger Flugzeugbau in Hamburg.

The German firm also recently announced plans for prototype production of a 6-to-14 place twin-jet transport designated the HFB-320 and roughly in the same category as the 12 place JetStar. HFB-320, with first flight scheduled in late 1963, undoubtedly could be modified as a NASSAR trainer at a later date if ordered by the German air force (see photo on p. 105).

Bundestag, in its review of the defense budget, also has questioned Defense Minister Franz Joseph Strauss in closed session on the progress of the European consortium production program for the F-104G.



First SAC Titon 1 Squodron Activated ot Lowry AFB

First squadron of Titan 1 intercontinental ballistic missiles entered the operational inventory of Strategic Air Command at Lowry AFB, Colo. Apr. 18. Three missiles from one of three launch complexes manned by the 724th Strategic Missile Squadron, 451st Strategic Missile Wing, are shown above in elevated firing position. Squadron has three complexes with a total of nine Titan Is. Titans are not combat ready, since they are not integrated into SAC's retaliatory plan, but could be fired in event of war. Crew training is lagging behind completion of the Titan complexes and a delay of one or two months can be expected in having most of the missiles in a ready status. Second squadron of Titans will be turned over to SAC before mid-May.

Defense Plans Shift in Contractor Policy

By Katherine Johnsen

Washington—Top Defense Department officials are focusing on earlier direct purchase of weapon system components and new standards for profits to prime contractors on work done by subcontractors, Paul R Ignatius, assistant secretary of the Army for logistics, reported last week to the Senate's Permanent Investigating Subcommittee

During three weeks of hearings on the Nike program, the subcommittee, headed by Sen John McClellan (D Ark), has repeatedly highlighted the profits made by Western Electric Co , the prime contractor, and Douglas Aircraft Co , the major subcontractor, on the work of subcontractors—including profits on the profits of subcontractors

Extensive testimony last week showed that persistent efforts by the Army since 1954 to break out the Nike program, launched in 1945, and eliminate mud dleman profits to Western Electric and Douglas were effectively blocked by Western Electric Breaking out involves procurement directly from the manufacturer, rather than through a weapons system contractor

Ignatius also told the subcommittee that he had recommended a company-by-company analysis of major weapon system contractors "to see what they need to keep healthy "

Services Claim Records

All three services claimed new world aircraft records last week, surpassing both U S and Soviet-held marks

- Army claimed time-to-climb helicopter records for the Bell YHU 1D Helicopter climbed to 6,000 meters (19,686 ft) in 5 min 51 sec and to 3,000 meters (9,843 ft) in 2 min 14 6 sec Previous records were held by the Kaman H 43B
- Navy flew a McDonnell F4H 1 to 30,000 meters (98,425 ft) in 371 43 sec , to 25,000 meters (82,021 ft) in 230 44 sec. and to 20,000 meters (65,616 ft) in 175 5 sec., exceeding time-to-climb records held by Air Force F 104
- Air Force claimed new records for payload-to-altitude and payload-at speed, both previously held by Soviets Boeing C-135B Stratolifter carried 30,086 kg (66,328 lb) to 47,170 ft. The feat also bettered Soviet records for 10,000, 15,000 and 25,000 kg to altitude. Aircraft also carried same payload over a 1,250 mi. course at 615 81 mph. at 20 500 ft , bettering Soviet records for carrying 5 000, 10,000 and 15 000 kg and establishing marks in the 20,000, 25,000 and 30,000 kg categories

Lt Gen John H Hinrichs, Army chief of ordnance, said that Army has already worked out an improved program for Nike Zeus production—which, he told AVIATION WEEK, is under "active consideration" by Defense Secretary Robert S McNamara It is based on Army's experience with Nike Ajax and Nike Hercules The program being considered is "much smaller" than the $10 billion that has been mentioned, Western Electric Vice President C R Smith said

Western Electric's Nike business dropped $100 million in 1961 and is expected to drop another $100 million this year, leaving the company very little government business unless Zeus is put in production Smith said The Fiscal 1963 defense budget earmarks $105 million for Nike Hercules

Army Ordnance Missile Command and Western Electric have already established a joint organization at Burlington, N C for top management and responsibility for the Zeus program, Gen Hinrichs reported He said Western Electric has formally recognized that the Army intends a progressive break-out of Zeus elements To make this possible he added, design documentation is being scheduled in the development period

A subcommittee summary showed that on 17 Nike Ajax/Hercules contracts, starting in 1951 and with a total cost to the Army of $1 5 billion, Western Electric and Douglas received a total $1146 million in mark-ups on subcontracts and purchases, Douglas $373 million and Western Electric $773 million Mark-ups were over and above firms' in house costs, including general and administrative expense

Douglas profit on the $1 5 billion program was 7 6% of total cost, or 44 3% of the company's own effort—excluding mark ups—according to the subcommittee's calculations which were verified by both Douglas and Western Electric Western Electric's profit was 7 9% based on cost, or 31 3% based on the company's own effort

Western Electric's Smith emphasized to the subcommittee that mark ups on subcontracts are a standard, long-standing procedure in defense procurement and that if they are eliminated the fee or profit to the prime contractor for his own effort would have to be much higher

The fact is that mark ups applied to subcontracts were simply a part of the pattern we negotiated with the Army to arrive at an overall profit for the overall job we did," Smith observed They were not designed as a specific measure of the contribution that we made to each subcontract"

He said that relating total profit to in plant effort has no standing in economics or accountancy

By this standard," Smith said, "the profits of the firm that maximizes its in-plant effort without regard to consideration of cost or efficiency would appear more reasonable than those of the firm that sets out to do a good job by more familiar standards."

McClellan disagreed with Smith that Western Electric's profits, related to investment devoted to government business, of 13% after taxes for the 1951-60 period were "reasonable" This compared with a 9 to 10% return on investment for Western Electric's telephone business

The profits of the other 20 top government contractors which averaged 15% on investment over the 10 year period, McClellan suggested "also merit investigation "

A sidelight developed by the subcommittee was that Western Electric was reimbursed under Nike contracts for $3 million it paid in rent for two government-owned plants in North Carolina, and also received a $290,000 profit on the $3 million When McClellan asked, "Why didn't the government just let you use the plant and cut out the $3 million and the profit too?," Smith said the situation is being corrected He pointed out that regulations have precluded rent-free plants because of the competitive advantage it gives the contractor

Bomare program, on which Boeing Co was the prime contractor, is the next major program slated for subcommittee hearings May 2

As with the Nike case, the focus will be on Boeing's profits on the work of its subcontractors Companies expected to precede Boeing in testifying are Lear Inc., International Telephone and Telegraph Co , Westinghouse Electric Co , Aerojet-General Corp , Food Machinery & Chemicals Corp , and Thiokol Chemical Corp Robert Thurrington, assistant general manager aerospace division, will head Boeing's witnesses

A General Dynamics/Astronautics subcontract for cables under the Atlas program is scheduled for a one or two day hearing According to Jerome Adlerman, the subcommittee counsel, the case is an outstanding example of big profits

Testimony developed that Western Electric opposed break out of key elements in the Nike Hercules system until production was phasing out and there would be little, if any, further procurements Army generally bowed to the contractor rather than have Western Electric withdraw its responsibility for the functioning of the system as a whole There was no significant break out in the Nike Ajax program

Army paid $23 million for Ajax manufacturing information so it could break out the program after the decision had been made to move its Hercules production

Western Electric voluntarily recommended direct Army procurement of the Hercules airframe from Douglas in June 1961—after steadfastly opposing this for four years The subcommittee noted that Western Electric's letter to the N Y Ordnance District making this recommendation followed by a few weeks the start of its investigation The Fiscal 1963 buy is expected to be the final Hercules purchase

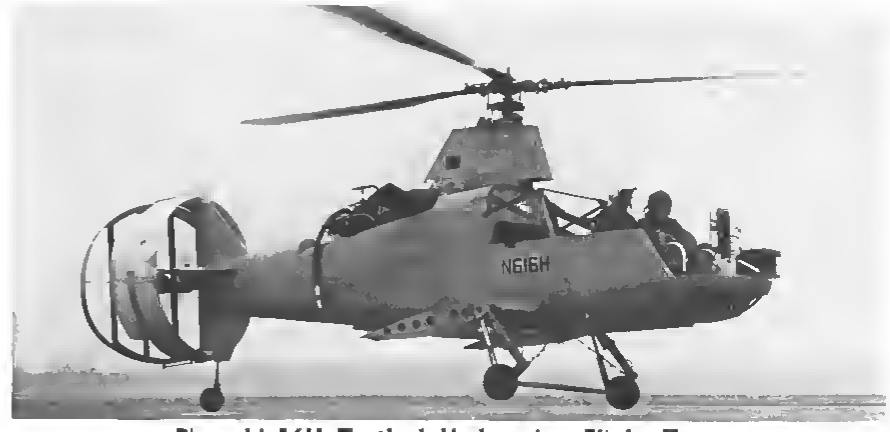
Walter Herr Western Electric's manager of government contracting, testified that a few break outs made by the Army over Western's opposition—for trailers launchers and sustainer motors—were proved to be correct in hindsight He assured that the company plans to apply its break out experience on Hercules to Zeus

On the trailers, the price to the Army went from $20,000 before break out to $10 700 in a procurement from Douglas to $10,300 in a procurement from Fruehauf Trailer Co , the manufacturer When the trailer procurement was opened to competitive bid the price dropped to $5 300

Lockheed 120-in. Firing

Lockheed Propulsion Co will fire a 120-in-dia solid propellant rocket before the middle of May at company's Potrero facility, near Banning, Calif

Motor consists of a center section and two end caps, is being developed under an applied research contract with Air Force's Space Systems Division's 6593 Test Group (Development) at Edwards AFB Prime purpose of the research program is to investigate thrust vector control The motor will utilize both Freon and nitrogen tetroxide, injected alternately from opposite sides of the nozzle to determine effects of inert (Freon) and reactive fluids on thrust vector diversion and thrust augmentation



Piasecki 16H Testbed Undergoing Flight Tests

Turbine-powered Piasecki Model 16H five place helicopter testbed has exceeded 117 mph during flight tests at Philadelphia International Airport Top speed reached so far was made with the landing gear down and cockpit unfaired and using 64% power Short-span wing designed to unload the main rotor during forward flight was not attached to wing root at the time of first flight, above Wings currently are being installed Initial test flights were used to test the anti-torque and directional control capability of vanes in the helicopter's ducted tail propeller Forward flight tests followed The 16H is powered by a 500-shp Canadian Pratt & Whitney PT6 gas turbine engine Company is aiming at a cruise speed of more than 150 mph and expects to receive Federal Aviation Agency certificate of airworthiness this year Development program is company sponsored

NASA Seeks Gemini, Apollo Crews

Washington—Applications are being sought for Gemini and Apollo crew candidates by the National Aeronautics and Space Administration which has set qualifications generally similar to those used when the seven Project Mercury astronauts were selected three years ago A maximum of 10 new pilots will be chosen

Major differences are that candidates must be five years younger than the 40 years age limit in the Mercury, and program has been opened to civilian, as well as military test pilots (AW Mar 19 p 34) Mercury was restricted to military experimental pilots

General qualifications are a degree or equivalent in biological sciences or engineering experience in jet test flying with preference given those presently in this field, test pilot rating obtained through the military, NASA or industry age under 35 at the time of selection next fall height limit of 6 ft

NASA is attempting to develop a uniform pay scale for the astronauts Salaries of the Mercury pilots range from $800 to $1,150 per month, depending on rank and the agency would like to equalize the pay probably at the scale of its own engineering test pilots, which reaches about $16 000 annually

At the time of the Apollo lunar landing flights NASA wants a pilot pool of about 21 astronauts, which will require another selection in two or three years

Applications for the present group should be sent by June 1 to Robert R Gilruth, director of the Manned Spacecraft Center in Houston Interviews and written examinations will be conducted in July, followed by physical examinations Final selection will be in September

NASA Studies Hypersonic X-15 Follow-on

By David A. Anderton

Washington—Hypersonic cruise research aircraft with orbiting capability is being studied by National Aeronautics and Space Administration's Office of Aeronautical Research as a follow-on to the North American X-15.

The aircraft could be used to demonstrate some of the powerplant and aerodynamic techniques of USAF's proposed Aerospace Plane, as well as to develop the technologies of recoverable boosters, hypersonic transports and orbiting vehicles.

Minimal studies of the concept by the NASA office envisage an aircraft with a maximum length on the order of 90 ft., and a maximum takeoff weight of 100,000 lb. The research plane would have the ability to take off and land at sites such as Edwards AFB, and would not require a launching vehicle as many predecessor X-craft did.

John Stack, NASA's Director of Aeronautical Research, hopes to conduct a 12-month study of the generalized characteristics of such a design before asking industry to submit proposals. It is probable that that phase will include some funded studies by industry in specific problem areas where NASA's in-house capabilities are lacking.

The entire program, as currently seen by Stack and others, could call for three flight test aircraft. One estimate is that it could cost a billion dollars to get the program to the status of the X-15 project today: three flying vehicles with about half of the flight-test program behind them. Cost to date of the X-15 program is about $250 million.

Stack emphasizes that all this data—size, weight, number of aircraft and program cost—is currently based only on rough estimates, and that the configuration shown here in an artist's conception is only one possible layout for such an aircraft.

AVIATION WEEK artist's concept of hypersonic cruise aircraft shows possible layout

Opposition Encountered

There is strong sentiment for and against the program within NASA. Stack's office wants to carry through the program as an extension of the long series of X-aircraft. Stack sees the project as one of the logical functions of the agency; he has long been an advocate of stronger support of aeronautical programs within NASA.

Opponents of the proposed aircraft feel that the step is too large to be started now, and that too many technologies have yet to be developed in order to make such a flight vehicle possible.

But whether or not a top-level NASA policy decision supports the study, some observers believe the project will continue. Because of the similarity between some of the proposed capabilities of the experimental design and the requirements for the Air Force's Aerospace Plane, there has been informal indication that USAF would be willing to fund development if NASA does not.

But it is obvious that then the research objectives of the program would be directed away from the scientific aims currently in NASA's thinking and toward end results more in line with military weapon development.

Basic aerodynamic properties of possible configurations now are understood to some degree, Stack says, but both powerplant and structure pose formidable technical problems.

Fuel Requirements

The requirement to sustain hypersonic cruise Mach numbers demands a fuel other than the standard hydrocarbons, and hydrogen is probably the best choice.

The amount to be carried would be large, which in turn means very large volume because of the low density of liquid hydrogen. Standard hydrocarbons weigh from six to seven pounds per gallon; liquid hydrogen weighs about six-tenths of a pound per gallon.

This means that the liquid hydrogen tank would dominate the structure and that it would have to double as load-carrying structure in order to keep operating weight empty at a minimum.

Stack pointed out that the X-15 design speed limits were set by contemporary metallurgy and were chosen to keep skin temperatures under limit values of 1,200 to 1,300F. "There was no need on that program for 'unobtainium,'" said Stack. "In contrast, the design performance of the new research aircraft will demand new alloys, new insulations and new ceramic coatings."

In addition, there will be extreme temperature differentials through the aircraft, ranging from the −423F level of the liquid hydrogen to the several-thousand degree values generated in combustion or on the skin. This will demand unusual structural layouts as well as new materials and processes.

Basic Engine

Stack said the powerplant would be a turboramrocket including an oxygen recovery system for the Aerospace Plane cycle. The basic engine might combine the three types in one unit, but it is more likely that there would be two separate powerplants on the new X-aircraft.

For takeoff and acceleration to Mach 3, a hydrogen-burning turbofan engine would probably be used. This technology has been developed to some extent by Pratt & Whitney Aircraft (AW Apr. 2, p. 55). The oxygen collection cycle takes place at hypersonic Mach numbers to accelerate the vehicle from Mach 3 to a speed approaching Mach 10; a hypersonic ramjet would be used. This could also be a hydrogen burner.

During acceleration to hypersonic speed, a special intake system would collect air which would then be processed through a liquefaction cycle. Liquid nitrogen would be rejected from the cycle although it might be stored on board the airplane to be used in some other applications. The liquid oxygen would be stored in tanks.

At the end of the collection period, when the aircraft had reached Mach 10, the liquid hydrogen fuel and liquid oxygen would be burned in a rocket engine to accelerate the aircraft to orbital speed. This type of powerplant also has considerable background behind it: one cycle has been developed at Marquardt Corp. and is code-named LACE for Liquid Air Cycle Engine (AW Nov. 6, p. 59).

Stack says this aircraft would provide real advances in the state of the art of many current technologies as well as providing a basic research aircraft tool for post-1970 space exploration.

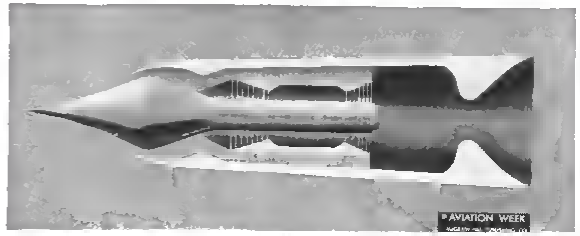
Soviet Boost Glider

Moscow—Discussion of a Soviet boost glide aircraft has been revived by the successful orbital space flights of Russian and U.S. astronauts, according to Cosmonaut Yuri Gagarin. Primary use might be as an intercontinental transport.

Designers of the rocket plane are considering both ablative materials and cooling liquids "to cool the surface of the rocket plane," Gagarin said. The aircraft would be boosted by a multistage rocket with a total thrust of about 1.4 million lb. and would be guided automatically and controlled by jets during most of its flight. It would use deceleration rockets as it re-entered the denser portions of the atmosphere and be landed on an airfield by the pilot, using aerodynamic controls.

Because the aircraft would travel at speeds of about 15,000 mph., "it is intended for intercontinental transport of a larger number of people and valuable freight," Gagarin said.

Stages of the rocket booster would separate "one by one [illegible] and would then return to earth with the help of parachutes," Gagarin said.



TURBORAMROCKET POWERPLANT combines three cycles in one structural shell

Ranger, Saturn, UK-1 Fill Launch Schedule

Washington—Lunar impacter, scientific satellite and a ballistic flight of a Saturn booster are scheduled at the Atlantic Missile Range this week, with priority given the Ranger 4 in the second attempt to rough-land a payload on the moon.

The Ranger window—time period in which the launch can be made—is Apr. 23-25.

Launch will be along the same trajectory planned for Ranger 3 (AW Feb. 5, p. 30) and the payload and instrumentation will be the same.

Second Saturn 1 test booster, designated SA-2, will be launched on a ballistic trajectory Apr. 25 if the Ranger is launched before then. The UK-1 ionospheric satellite—a U.S. satellite structure containing British instruments—is scheduled Apr. 26.

Ranger launch schedule is:

- Apr. 23—88-min. window from 3:09 p.m. (EST) until 4:37 p.m. Transit time to moon is 65 hr. 1 min.
- Apr. 24—92-min. window from 3:43 p.m. to 5:15. Transit time is 64 hr. 12 min.
- Apr. 25—98-min. window from 4:08 p.m. to 5:46 p.m., with a 63 hr. 27 min. transit time.

National Aeronautics and Space Administration scrapped plans to install a cutoff table in the Atlas booster which would operate on ground command because there was insufficient time to make this modification and still meet the launch window requirement. The Atlas attained an excessive velocity in the Ranger 3 mission.

The 730-lb. spacecraft to be launched by an Atlas-Agena B contains moonquake, lunar photography, gamma ray and radar reflectivity experiments.

The SA-2 launch is the second in a program of 10 Saturn development flights leading to Apollo earth orbital mission assignments for the vehicle. First C-1 test vehicle, SA-1, was launched Oct. 27, reaching an apogee of 85 mi. and a range of 215 mi. (AW Nov. 6, p. 30).

The 132-lb. S-51 international satellite is designed to orbit from 200-600 mi. and will be launched by a NASA-Douglas Delta vehicle. After a failure in its initial use, Delta has been successful in seven satellite launch attempts.

Titan 3 Review

Ad hoc Institute of Defense Analyses committee is reviewing Air Force Space Systems Division's Titan 3 program and will report to Department of Defense by May 1. Specific decisions on configurations and payloads are expected to be made about 10 days later.

At least three versions of Titan 3 launch vehicles are contemplated, and a number of possible payloads—including Dyna-Soar, Advent Inspector, Advanced Samos and Midas—are being considered. Committee, known also as the Bladi Committee, was briefed by a Boeing Dyna-Soar team on Apr. 13 and was scheduled to confer with SSD and Aerospace Corp.'s Titan 3 program chiefs late last week. The committee's report will be made to Dr. Lawrence Kavanau, special assistant for space to the Director of Defense Research and Engineering.

TWO X-15 RESEARCH AIRCRAFT will fly about 35 missions aimed at scientific tests in aeronautical and space sciences. Second X-15, shown just after drop at the start of its speed-record run last Nov. 9, and first aircraft will be flown in two-year program extension.

Out-of-Atmosphere Flight Tests Will Expand X-15's Research Role

Washington—Two of the three North American X-15 hypersonic research aircraft are being assigned to a new series of experimental flight tests planned around the capability of the X-15 to operate out of the atmosphere.

A minimum of 35 flights will be added to the original X-15 flight program, largely for investigations in space and aeronautical sciences. One major program—an experiment in ultraviolet stellar photography—has already begun at the University of Wisconsin under a contract awarded by the Office of Astronomy and Solar Physics of the National Aeronautics and Space Administration.

This experiment and other associated work will furnish backup and instrumentation data for NASA's Orbiting Astronomical Observatory program. Typical test work also will include collection of micrometeoroids, measurement of atmospheric density, and measurement of the ultraviolet background of both earth and sky.

The original test program of the X-15 is about half-finished, it was planned to explore the phenomena of aerodynamic heating, control, hypersonic aerodynamics and structures, biomedical aspects of manned aircraft and exit from and re-entry into the earth's atmosphere. The additional 35 flights will add about two years to the total program.

NASA and the Air Force have approved the follow-on experiments that are now scheduled and are funding them jointly. Approximately $10 million has been allocated for this year by USAF and about $7 million by NASA.

X-15 altitude performance range puts it above balloons and below satellites, in a range of considerable interest to space scientists. Use of the X-15 for these studies complements the use of sounding rockets, but the X-15 can carry a much larger payload and is, of course, recoverable.

Cost of each X-15 flight is about $300,000, which places it high above some sounding rockets, but cheaper than others.

All of the data collected will be returned on film, with more bits of information than can currently be handled by payload-sized telemetry. There is a further advantage that instrumentation can be recalibrated after a flight as well as before, so that the effects of any shift in base lines or hysteresis in the system can be determined exactly.

Third X-15, modified to use an adaptive control system is not part of the expanded scientific program. Its next few flights will investigate the high angles of attack associated with recovery from high altitudes at the attitudes required to keep dynamic pressure at a minimum.

Aerojet Will Develop Propulsion for Apollo

Washington—Aerojet-General Corp. will be awarded a contract to develop the propulsion system for the Apollo service module using the same propellants as in both Titan 2 stages.

Negotiations between Aerojet and North American Aviation Space and Information Systems Division, prime Apollo contractor, are under way and the contract will be valued at about $12 million.

Service module propulsion system will be used for abort, course control and lunar takeoff (AW Mar. 19, p. 32). The pressure-fed engines will be fueled by storable hypergolic propellants nitrogen tetroxide and Aerozine-50 the latter an Aerojet development consisting of an equal mixture by weight of hydrazine and unsymmetrical dimethylhydrazine (UDMH). Thrust can be controlled over a wide range to a maximum up to 20,000 lb.

In other major contract developments in manned space flight, proposals will be due Apr. 23 at Langley Research Center on the Little Joe 2 launch vehicle to be used for Apollo spacecraft ballistic development flights, and Westinghouse Electric Air Arm Division won a contract for the radar system to be used in Gemini two-man spacecraft rendezvous missions.

Little Joe 2 will be a cluster of seven Aerojet Algol solid propellant motors, to be launched from Pad 5 at the Atlantic Missile Range to qualify design of the Apollo vehicle (AW Mar. 19, p. 32). Proposal requests went to major airframe contractors last month.

This vehicle follows a concept originated to qualify the design of the Project Mercury capsule and escape system in maximum dynamic pressure and other severe aerodynamic conditions.

The Westinghouse contract was awarded by McDonnell Aircraft Co., prime contractor to National Aeronautics and Space Administration for the Gemini two-man spacecraft. Westinghouse has long been the Navy's primary supplier of airborne radar for interceptor aircraft, including the McDonnell F4H. The company also built the terminal guidance for the USAF-Boeing Bomarc missile system.

Aerojet has had considerable experience in storable propellants, using inhibited red and white fuming nitric acids in combination with UDMH in its Able, Ablestar, Delta, Vanguard and Aerobee stages.

Brainerd Holmes, director of NASA's manned space flight program said the propulsion system for the Apollo service module has "one of the most vital roles in the Apollo spacecraft," with a reliability of 99.9% demanded.

European Space Unit Agrees on Program

London—Seven nations last week agreed to a convention formally establishing a European Launcher Development Organization (ELDO) aimed at launching a series of satellites by 1965-66 using de Havilland Blue Streak as primary booster (AW Apr. 9, p. 28).

In addition to the United Kingdom signatories pledged to formulate a working program are Australia, Belgium, France, West Germany, Italy and The Netherlands, according to Minister of Aviation Peter Thorneycroft.

Under the plan, the French will develop the second stage—probably Veronique—and the West Germans will head a design team for the third stage. The Italians are working on the first satellite configuration.

Final signings came just two years after the controversial cancellation of Blue Streak as a military weapon. However, a number of countries have dropped out of the civil launch program since it was first pushed by Thorneycroft in an unprecedented international sales drive. They are Spain, Sweden, Switzerland, Denmark, Austria and Norway.

Australia's contribution will be use of the Woomera rocket range. Britain will contribute, over a five-year period, $81 million. Other shares are France $51 million, West Germany $45 million, Italy $21 million and Belgium and The Netherlands, $6 million each.

Headquarters for the European Launcher Development Organization will be in Paris. The group will be governed by a council of national representatives. The senior staff will be appointed by the council.

However, in West Germany, the Bundestag finance committee has recommended that the Fiscal 1962 budget request of $8.5 million for ELDO be trimmed by about $5 million and that anticipated funding programs be approved by the committee on a step-by-step basis before being spent.

Dr. Seigfrid Balke, minister of atomics and space research, told German aircraft industry representatives that the committee ruling will be debated in the Bundestag when West Germany's entry in ELDO comes up for formal ratification. Balke said the industry can meet the ELDO schedule and deliver a third stage to Woomera in 1965.

The Italian National Council of Research last week was accelerating design of a satellite which will be launched next year by a Scout rocket from a vessel in the Indian Ocean near Somalia. This program is being conducted in cooperation with NASA. The Italian government appropriated $2.4 million for the Scout launch project.

BRISTOL T.188 stainless steel research aircraft designed to eventually reach Mach 3 speeds lifts off on its first flight last week.

Mach 3 Bristol T.188 Research Aircraft Completes First Flight

London—Bristol T.188 stainless steel Mach 3 research aircraft successfully completed its first flight Apr. 14 from the Bristol Aircraft plant at Filton, England. The aircraft is now at Boscombe Down for extensive ground checks of engine and airframe.

Piloted by Bristol Chief Pilot Godfrey Auteve, the aircraft was aloft 22 min. Auteve said top speed reached was 300 kt. at about 15,000 ft. Approach speed has been classified, but Auteve described handling characteristics as much like the Hawker Hunter.

Second Aircraft

Second T.188 now is being built at Bristol and will roll out at the end of this year. Another T.188 airframe is at Royal Aircraft Establishment, Farnborough, for heat tests.

Ministry of Aviation said the aircraft will be used for research into problems of supersonic flight and also for a military program. Referring to the latter, Dr. A. E. Russell, technical director of Bristol, said there are no immediate plans to mount ramjet engines in the T.188.

Initial flight test program will center on speeds well below Mach 3 for which the airplane is designed, he said. Power plants are two de Havilland Gyron Juniors which are not designed for Mach 3 performance.

However, Dr. P. H. Calder de Havilland engines development chief, said that new Gyron Junior engines are now on the testbed and will have the Mach 3 capability with what he called "minor internal modifications." Externally the new engines will be identical with the present powerplants, he explained. Each produces 14,000 lb. thrust.

Dr. Russell said flight test program probably will be run over water, to reduce the problems of supersonic noise. First airplane probably will be grounded for at least a month to reduce data and check the hardware.

The T.188 is Britain's second aircraft designed to explore the supersonic transport regime, the other is the Handley Page slim delta, to investigate handling at low speeds and a third still being built, is the Fairey FD.2 with a modified ogee wing, similar to that of the Sud Super Caravelle.

Space Patent Policy Criticized; Changes Urged by House Group

Washington—Current patent laws should be rewritten to give the National Aeronautics and Space Administration more flexibility in determining whether title to an invention should be taken by the agency or given to the contractor, according to a report filed last week by the House Science and Astronautics patents subcommittee.

The subcommittee, headed by Rep Emilio Q Daddario (D Conn), said NASA's current patent provisions were harming the space program by discouraging the marketing of inventions The patent section of the 1958 space act, Rep Daddario said, "is too dangerous to the nation's position in the space race to be permitted to stand "

Current law requires NASA to take title to inventions made by its contractors Title can be waived by the agency, but the procedure is cumbersome NASA itself until last year sought a change in the patent laws. The space agency did not renew the effort in Congress last year, partly because it did not want to provoke a controversy which might interfere with its sharply increased budget requests and partly because patent problems did not appear severe (AW June 5, p 37, Dec 11, p 27)

Despite this lack of impetus from NASA, the subcommittee has pursued the investigation which started in August, 1959, with extensive hearings and last week issued a 27-page report The parent House Science and Astronautics Committee is not expected to consider adoption of the report until May or June because of other business And views are so divergent in the Senate about government patent policy that final congressional action probably will not occur this year without White House pressures

Even so, the subcommittee report represents the most up-to-date analysis by Congress of patent problems stemming from the 1958 National Aeronautics and Space Act. These were the two key subcommittee recommendations

- **NASA's administrator** should retain a royalty-free license to inventions made under space contracts, but should let the contractor keep title to the invention unless the public interest dictated otherwise This would reverse the present procedure whereby NASA takes title to the invention and later waives title, only if public interest dictates
- **Contractors who were given** title to space inventions but did not exploit them within five years should be required to license other contractors to market the inventions This authority should rest with NASA administrator

These recommendations are contained in a bill recently introduced by Rep Daddario and endorsed by the majority of the subcommittee. The bill also provides guidelines for determining whether the NASA administrator should obtain more than a royalty-free license to an invention Such additional rights would be desirable under the bill if the "public health, safety or security" is involved, if the inventions made under the contract 'depended in substantial degree upon the prior or parallel conceptions of other parties under government contracts " or if the technical field is so new that any inventions in it would not be developed without substantial government financing."

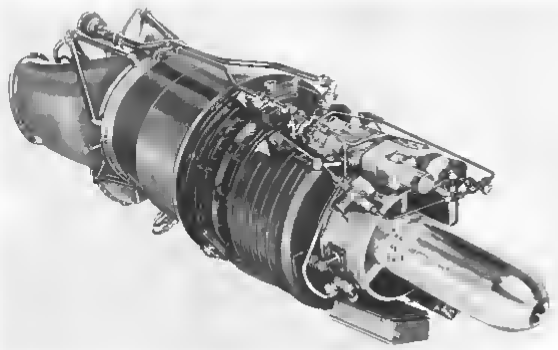
The subcommittee said the essence of industry's dissatisfaction with NASA patent philosophy is twofold

- **Government** needs no more than a royalty-free license to inventions since it does not exploit federally owned patents
- **When the government** takes title to inventions, it reduces the incentive of the inventing contractor to exploit them commercially, delaying development

As for government objections, the subcommittee said that NASA and the Defense Department felt that requiring NASA to take title initially "not only made private contractors skittish about the kind of research they were willing to undertake for NASA, but they complicated and fouled joint research projects which were extremely important to both agencies " Defense is not required by law to take title to its contractors' inventions

Answering the arguments that since the government pays for the research it should get any inventions stemming from it, the subcommittee said "In very few instances does the government bear all the costs of developing inventions or even the major part of them In the vast majority of cases the government awards research contracts according to the experience, knowledge and skill developed by the contractor The government takes advantage of a situation which exists It puts up federal money in order to reduce this know-how and the ideas of the contractor into a state that is useful to the government This is what the government bargains for and what the taxpayer pays for "

Rep William Fitz Ryan (D-N Y) dissented from the majority view expressed by the nine-member patents subcommittee He endorsed the present NASA patent laws, quoting Assistant Attorney General Lee Loevinger who contended the subcommittee's recommended policy would have "serious anti-competitive consequences" in the space technology field Loevinger also said there is no indication that present NASA policy is discouraging contractors from seeking NASA contracts.



Daimler-Benz PTL 6 to Be Unveiled

Daimler Benz PTL 6 turboshaft engine, to be unveiled next week at the Hanover Air Show in Germany, is designed to develop 1,050 hp Power takeoff can be either from the front or the rear of the engine Over-all length is 70 in , maximum diameter is 20 in , and dry weight is 440 lb. Engine is a free-turbine type, with a single-stage power turbine and a two-stage turbine driving the gas generator The compressor has four axial stages followed by a single-stage radial compressor Combustion chamber is annular. Comparable U S engine would be the early General Electric T58-6, which developed 1,050 hp in a 55 in x 16 in envelope for a dry weight of 271 lb.

GENERAL DYNAMICS | CONVAIR

TITANIUM FABRICATION CAPABILITY

Convair has the capability to manufacture a wide variety of reproducible high quality titanium parts and assemblies for aerospace vehicles—particularly items formed with commercially pure alpha alpha beta and beta titanium alloys Such titanium aircraft components as sandwich construction panels tail cones fuselage frames wing leading edges ducts shear panels compression panels wing box sections and spars have been produced and tested at elevated temperatures

Parts have been fabricated from sheet material with maximum thicknesses ranging from 0 010 in to 0 125 in Titanium materials successfully used in Convair production programs include—

- Commercially pure ti sheet and bar form
- Ti 8-Mn sheet and plate form
- Ti 6Al-4V sheet form
- 4Al-4Mn bar and forgings
- 5Al-2 4Sn (A110 AT, alpha type) sheet and bar
- 7Al-4Mo (C135 A Mo)

These materials were used in finished production airframes weighing 400 lb (F-102 interceptor) 500 lb (F-106 interceptor), 850 lb (880 jetliner), and 1 000 lb (990 jetliner)

Convair has also investigated the following titanium alloys for possible use in parts fabrication

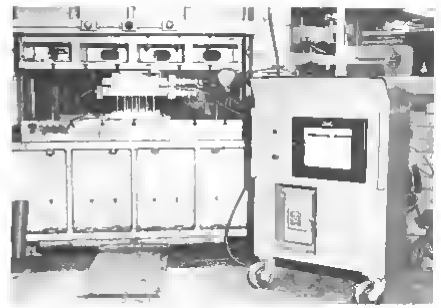
- Ti 4Al 3Mo 1V
- Ti 2 5Al 16V
- Ti 6Al 4V
- Ti 5Al 2 75 Cr 1 25 Fe (RS 140)
- Ti 8Al 1Mo 1V
- Ti 13 Cr 11V 3Al (B120 VCA)

TITANIUM FACILITIES

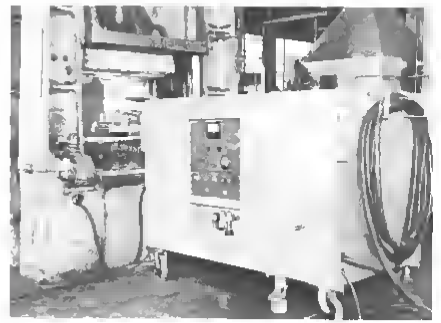
Hot form die built by Convair is used for hand-on-brake operation Die has temperature capability to 1 400 degrees F, and provisions for water cooling.

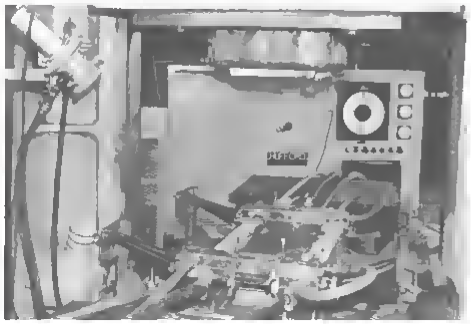
Convair-designed and built quartz lamp heating unit, used with drop hammer and conventional Kirksite tooling, provides rapid heating rates for 990 jetliner titanium parts production Heat up unit hooks into drop hammer control system and automatically retracts when press is operated

Eight foot, corrugated sine wave spar made of alpha titanium Born through welding technique was used to open air with tungsten inert gas welding and argon gas for cover and back up



Convair power control cart used in the hot forming of titanium parts Cart provides automatic die temperature control of six tools or six separate areas of one tool or combinations thereof Equipment was also used to manufacture detail test parts by elevated temperature methods

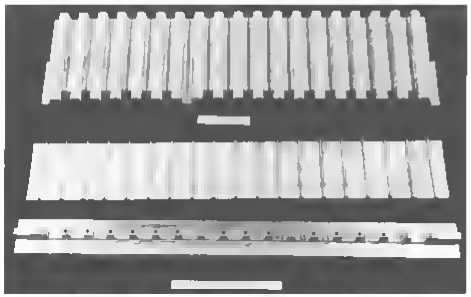




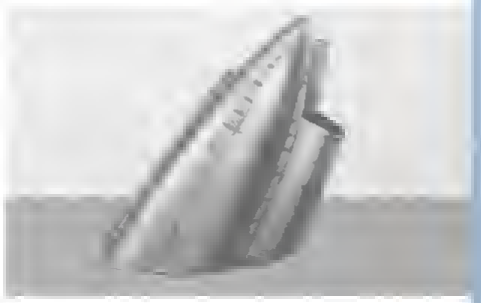
Resistance heating is used in the drop hammer forming of 680/990 parts

Titanium preform being returned onto the mandrel

TITANIUM PARTS FABRICATION



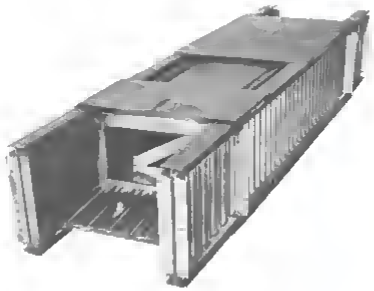
Alpha beta titanium panel details were formed at room temperature and hot sized to final configuration. Modified corrugations and subcorrugations shown here were formed of Ti 4Al 3Mo 1V alloy and the spar of Ti 6Al 4V



Detail parts for this all alpha beta titanium (Ti 4Al 3Mo 1V alloy) tail cone were formed in solution treated condition then fully aged prior to assembly

Chemically milled alpha beta titanium (Ti 4Al 3Mo 1V alloy) was used by Convair to produce test aircraft wing and fuselage skins. The material is aged between heavy flat platens then rolled to contour in aged condition

Spot and fusion welded alpha titanium fuel cell

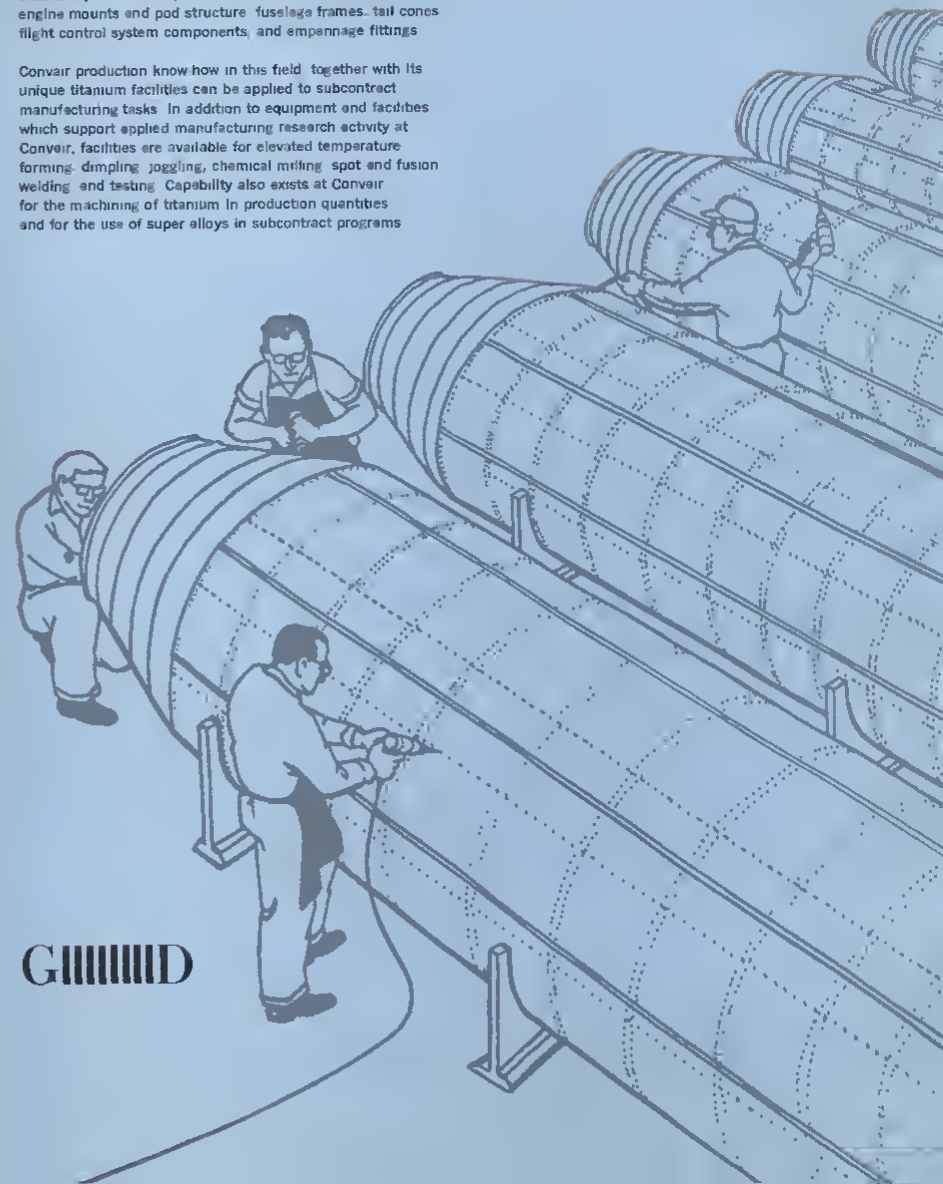


GENERAL DYNAMICS | CONVAIR

TITANIUM FABRICATION CAPABILITY

Since 1954, Convair has fabricated approximately 1½ million pounds of titanium parts for aerospace vehicles. Titanium parts now in production at Convair include jet engine mounts and pod structure, fuselage frames, tail cones, flight control system components, and empennage fittings.

Convair production know-how in this field, together with its unique titanium facilities can be applied to subcontract manufacturing tasks. In addition to equipment and facilities which support applied manufacturing research activity at Convair, facilities are available for elevated temperature forming, dimpling, jogging, chemical milling, spot and fusion welding, and testing. Capability also exists at Convair for the machining of titanium in production quantities and for the use of super alloys in subcontract programs.



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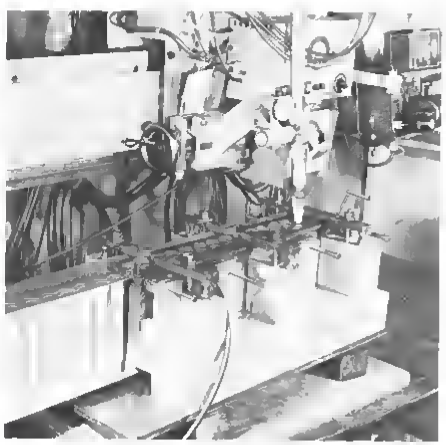
TITANIUM WELDING

Convair has had considerable experience in the welding of titanium parts—resistance and inert gas welding methods were first employed in 1954. Applied manufacturing research personnel at Convair are constantly investigating new titanium welding techniques and equipment.

The titanium welding equipment available at Convair for fabrication techniques is listed in capability folders entitled "Applied Manufacturing Research and Process Development — Experimental Manufacturing and Processing."

This welding equipment was used to weld thin gage titanium sinusoidal web spars. Close tolerances were maintained to accommodate thin gages and provide the exact alignment of component parts required for the welding operation.



(top)
Convair used super alloy N-155 to fabricate F-106 ejector cone

(bottom)
Titanium was used extensively in manufacture of 990 jetliner engine pods

Illustrated on front cover
Production line for F-102 titanium engine shroud

SUPER ALLOYS

To insure production of high strength assemblies that maintain aerodynamic smoothness and dimensional tolerances when heated to elevated operating temperatures, Convair has extensively tested such super alloys as N-155, R-235, L-605, Rene' 41, J-1650 and Hastelloy X. These tests involved formability, resistance spotweld and fusion welding, and machining of the super alloys in support of re-entry and supersonic cruise vehicle studies. Convair recently conducted an investigation of welding techniques for joining nickel base alloys in tall gage ranges.

The data resulting from the super alloy tests was used in several Convair production programs—for example, forming data obtained for super alloy N-155 was used in the fabrication of F-106 parts.

ADDITIONAL INFORMATION

An almost unlimited potential exists at Convair for successful completion of aerospace subcontract programs—The company's diversified research and manufacturing facilities, a stable work force with an excellent record for on-schedule delivery of quality products, San Diego's major air, rail, trucking and shipping accommodations for rapid transit of production materials and finished products, mild climatic conditions conducive to outdoor testing and overhaul tasks, in-plant location of Navy and Air Force inspectors, and the proximity of numerous military test installations in Southern California.

Convair subcontract capabilities are covered individually in separate folders entitled Machine Shop • Sheet Metal Fabrication • Tool Manufacturing • Honeycomb and Metal Bond Manufacturing • Scotch-weld Bonding • Plastic Parts Production • Experimental Manufacturing and Processing • Applied Manufacturing Research and Process Development.

For further information concerning Convair's experience and facilities for subcontract programs, please contact:

Director of Marketing
General Dynamics | Convair
P.O. Box 1950
San Diego 12, California

GENERAL DYNAMICS | CONVAIR

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That's the big feature in Delco Radio's new 175 VA and 250 VA static inverter power supplies. These *all-transistor* units offer increased reliability through simplified circuits. Both static inverters are designed for either airborne or ground applications and will withstand overload and output short circuit conditions indefinitely, delivering at least 110% of rated output before going into overload protection. Units automatically recover to full output upon removal of overload and short circuit. Units are designed to meet the environmental requirements of MIL-E-5272C. For further information on military electronics write Delco Radio's Military Sales Department.

ELECTRICAL SPECIFICATIONS

175 VA STATIC INVERTER		250 VA STATIC INVERTER	
Input		Input	
Voltage	27.5 VDC ± 10% per MIL-STD-704	Voltage	27.5 VDC ± 10% per MIL-STD-704
Output		Output	
Power	175 VA single phase 0.8 lag to 1.0 power factor	Power	250 VA single phase 0.8 lag to 1.0 power factor
Voltage	115 V adjustable from 110 to 120 volts	Voltage	115 V adjustable from 110 to 120 volts
Regulation	1 volt change for any variation of load between zero and 110% of full load and input voltage between 25 VDC and 30 VDC	Regulation	0.7 volt for any variation of load between zero and 110% of full load and input voltage between 25 VDC and 30 VDC
Frequency	400 ± 1 cps Frequency changes less than 1.0 cps for all environmental load and input voltage variation	Frequency	400 ± 1 cps Frequency changes less than 1.0 cps for all environmental load and input voltage variation
Distortion	Less than 5% total harmonic	Distortion	Less than 5% total harmonic
Efficiency	80% at full load	Efficiency	80% at full load

DELCO RADIO

Division of General Motors • Kokomo, Indiana

THE FIVE O'CLOCK TAUBE

LEACH HERITAGE OF THE AIR — 19

The bird like Rumpler Taube sailed over the Gare de l'Est section of the city for nearly an hour with the load of three small bombs and three message containers. Finally, when the bombs were dropped, surprised Frenchmen thought a gas explosion had struck the heart of the city.

It was August 30, 1914. The impossible had happened. Two Germans—a pilot and his observer—had invaded Paris. And with each bomb came a weighted message attached to a 7-foot banner in German colors. The pilot's message: *The German Army stands before the gates of Paris. You have no choice but to surrender.—von Hiddessen.*

Lieutenant Ferdinand von Hiddessen was born on December 17, 1887 in Westphalia. True to the traditions of his noble, military family, he entered military training for the German Army when he was 12 years old. At 25, he was a senior Lieutenant of the 24th Regiment of the Darmstadt Dragoons.

But the bright young officer yearned to fly. So in 1911, he became the 47th licensed pilot to receive his wings from the Deutsche Luftfahrer Verband and, in 1912, flew the first German Airmail flight.

When World War I began, he was assigned to *Feld Flieger Abteilung II* in Belgium, where he and his observers conducted some of the earliest military reconnaissance flights of the war, including the bombing of Paris. Following von Hiddessen's dramatic assault on the French capital, the city was bombed repeatedly by the Taube machines.

After their initial panic, Parisians came to accept the somewhat regular appearance of German planes over the city. In fact, business boomed at sidewalk cafes in the late afternoon as patrons became more and more curious to get a look at what they called "the five o'clock Taube."

When the war broke out, nearly half of Germany's army aircraft were of the Taube type—that is, bird-like in appearance and typical of a design principle originated by the Austrian engineer Dr. Josef Etrich. Others copied his design, and versions of the Taube soon were being produced by more than 20 companies.

The Rumpler type 4C Taube, last of that company's monoplane series, first appeared in January, 1914. In July it set a world's altitude record of nearly 20,000 feet. The plane differed markedly from its predecessors. It featured rudimentary ailerons instead of the wing-warping principle of earlier models. Its 100 hp. Benz or Mercedes engine gave it a top speed of 75 mph, and a 45-foot wing span helped it climb to staggering heights.

Instead of becoming famous for the first bombing of Paris, von Hiddessen received the Iron Cross for his feat and continued his observation missions, which most military men of the time considered the airplane's most important role in war. Early in 1915, while flying an Albatros biplane, von Hiddessen was shot down by French anti-aircraft fire near Verdun. Wounded slightly in one arm, he was sent to a prison camp for the duration of the war.

Today, at 74, von Hiddessen lives in the Black Forest and is revered by his countrymen as one of the "Old Eagles" of German Aviation.

Heritage of the Air

One of the most inspiring chapters in the history of technical evolution is the story of the men and flying machines of World War I. It is the highly personalized story of brave men—and the wood, wire, linen and rudimentary technologies that converted manpower to airpower. Today Leach Corporation observes its 42nd year in electronics with the presentation of this Heritage of the Air series.

★ ★ ★

Technical Director for Heritage of the Air is Lt. Col. Kimbrough S. Brown, USAF

House Passes $47.8-Billion Defense Bill

By George C Wilson

Washington—House last week passed a bill to appropriate $47,839,491,000 for defense for Fiscal 1963—a record peacetime amount slightly less than President Kennedy requested but continuing more than he asked for such programs as the B-70 and the Air Force Boeing Dyna-Soar

House passage represented an endorsement of President Kennedy's basic decision to strengthen conventional armed forces as well as the nation's nuclear capabilities Chairman George H Mahon (D.-Tex.) of the House Appropriations Defense Subcommittee said the resulting balance of forces represents "a higher plateau" which would have been reached "sooner or later under any administration" because of the changing demands of the cold and hot wars threatening the U S

Few Challenges Made

There were relatively few challenges to the bill during House debate last week. The House followed the lead of its appropriations committee rather than its Armed Services Committee by adding only $52 9 million to President Kennedy's B-70 program The President sought $171 million for airframe and engine development and $52 million for radar and other components which could be used on the B-70 The House Appropriations Committee recommended adding another $52 9 million to the components fund The House Armed Services Committee had recommended increasing the B-70 program to $491 million so the Air Force could build three reconnaissance-type aircraft (AW Apr 16, p 26)

Rep Melvin R Laird (R.-Wis.) of the defense subcommittee said he had proposed adding $42 million to the Dyna Soar program because "we must clearly recognize that if man can go into space for peaceful exploration and research, he can use this same environment for military purposes Those people in this country that are today placing all emphasis on getting to the moon at a cost of billions of dollars are making a mistake" The $42 million addition adopted by the House brings the Fiscal 1963 funding for Dyna-Soar to $157 million

Another member of the subcommittee—Rep Daniel J Flood (D.-Pa.)—said it was a mistake not to add money to the Army's Nike-Zeus program (see p 24) "The Eisenhower Administration made a mistake for the last three years," he said, "when they did not put money into this bill to study the long-range production of hardware so that when we did break through we could get into production And the Kennedy people are just as wrong because they have refused to do it" Rep Flood also decried authorizing another conventionally-powered aircraft carrier rather than a nuclear one

All told, the House bill as it went to the Senate provided for increases of $698,792 000 and decreases of $766,301,000 for a net reduction of $67,509,000 The resulting $47,839 491 000 total compares with $46 494 956,000 appropriated for the same purposes for Fiscal 1962 and $40,297 657,000 for Fiscal 1961 Military construction, military assistance and civil defense are covered in other appropriation bills still pending

Besides additions for the B-70 and Dyna-Soar, the House voted these increases for other major military programs

- **Navy T3J-1 aircraft**—$16,970 000 to buy an additional 36 aircraft The unit costs rose so sharply after the Air Force stopped purchasing its version of the aircraft, the T-39, that the Navy could buy only 16 with the $18 100,000 in the Kennedy Administration budget

Midas, Discoverer Shots

Satellite launched at 10 56 a.m. EST Apr. 9 from Pt. Arguello, Calif., by an Atlas D/Agena B vehicle into a polar orbit was the Midas 5 infrared early warning vehicle intended to spot ballistic missile launches It is expected to transmit for 42 days from date of launch One experiment aboard was measuring damage inflicted by Van Allen belt protons

Satellite has not been identified by the Air Force, under a new Defense Department policy which permits no identification of certain military space vehicles by their proper names (AW Apr 16, p 35)

Satellite boosted into polar orbit Apr. 17 from Vandenberg AFB Calif., by a Thor Agena B vehicle carried three infrared ultraviolet radiometers for determining disposition, concentration, and reflective characteristics of water vapor and ozone in the earth's atmosphere, as viewed from space

The satellite probably was Discoverer 39 and served as a proving vehicle for refined equipment for the Midas early warning satellite.

Indications are that a more definitive policy will be implemented which also will oblige contractors involved to use code designations, instead of popular names, when referring to military space boosters and satellites.

The appropriations committee said the additional money "will maintain the production rate at an efficient and economical level" and result in savings of $5.6 million in the cost of procurement at the revised unit cost

- **Mark 46 torpedo**—$11 5 million additional "to insure keeping this advanced type torpedo on a development and procurement schedule looking toward its fleet availability to meet the threat of the 1967-1970 time period" The committee said it expects the Navy "to make all possible efforts to keep this highly essential anti-submarine warfare weapon, which vastly increases the kill potential of our weapons systems against modern nuclear deep-diving submarines, on the desired schedule"
- **Army reserve strength**—$58 8 million additional to maintain the Army National Guard at 400,000 and the Army Reserve at 300,000

Reductions Made

These were among the cuts made by the House

- **MMRBM**: $20 million was taken from the Air Force's $100 million research and development request for the mobile medium range ballistic missile The committee said that since the MMRBM program had been stretched out by addition of a "program definition phase" (AW Apr 2, p 22) the full amount could not be "profitably utilized" The committee also said development of the weapon should not precede international negotiations
- **Advent**—$5 million from the $100 million requested The committee said that since the Army was reviewing this communication satellite program, partly because of difficulties with the lifting capacity of the Centaur booster, the full amount requested probably could not be profitably used in Fiscal 1963
- **C-141 transport**—$10 million from the $207 7 million the Air Force requested for procurement The committee said "despite the obvious commercial potentialities of the aircraft, no specific arrangements have been made with the producer to provide for a portion of the development and initial production costs to be shared with commercial sources" The committee said such arrangements should be made "at once" and said it was making the reduction to "achieve this action"
- **Non-profit corporations**—$5 million from the $166 039,000 the Air Force requested "The value of such organizations to the Air Force is not denied," the committee said, "but the committee feels that the continuing growth in contracts for such technical and management services pending further review of the requirement is not advisable"

The committee added a section to the defense bill limiting to 15% the amount colleges and other organizations could charge to overhead in carrying out costs for research contracts Several university leaders wired members of Congress that such a limitation would impose severe hardships on their institutions since their indirect costs often exceed 15% on government contracts

The appropriations committee did not repeat its action of last year and add a section to its bill restricting defense advertising Committee spokesmen said corrective action taken by the Defense Department since last year made the statutory restriction unnecessary

BS.94 Engine Thrust May Grow to 10,000 lb.

Geneva—First step in the planned development of the Bristol Siddeley BS.94 variable thrust turbojet engine planned for the Focke-Wulf 1262 VTOL close support aircraft probably will be the retrofit of a standard BS.75 turbofan engine with fore and aft swivel nozzles added for vertical lift

Initial retrofit may be made sometime early next year on the BS.75 prototype now undergoing test stand trials Planned thrust growth will be from the present 7,550 lb. to 8,500 lb. on initial operational versions of the BS.94 Thrust on later versions may be boosted to approximately 10,000 lb Fore and aft nozzle arrangement for deflecting the engine's thrust from the vertical to the horizontal will be similar to that employed on the BS.53 presently powering the Hawker Siddeley P.1127

Under present planning, the West German air force hopes to adopt the FW.1262 as a standard close support replacement for the Fiat G.91 (AW Apr 9, p 26). BS.94 in the Focke-Wulf design would be augmented by two Rolls-Royce RB.162s for vertical lift

Life Detection Study

Simple method of detecting life forms on other planets will be the goal of a study to be carried out for the National Aeronautics and Space Administration by Aeronutronic Division of Ford Motor Co., Newport Beach, Calif

NASA wants Aeronutronic to determine the feasibility of a small, light weight system which would be both reliable and foolproof and which could be flown piggyback aboard a Mariner spacecraft Aeronutronic indicated it will investigate a system based on certain dyes that change color when brought in contact with protein molecules—particles found in all living matter Data would be telemetered back to earth

Hanover Show Draws 170 Foreign Exhibitors

Hanover—Fourth annual Hanover Air Show, which gets under way here this week has blossomed into a wide-ranging international exhibit this year with a total of some 170 companies planning displays

Running from Apr 29 through May 5 at Hanover-Langenhagen airport, the show is scheduled to include exhibits by at least 75 foreign firms Among them are approximately 40 from France, 15 from Great Britain and 10 from the U S Growth of the post-war West German industry is evidenced by its planned participation of about 95 airframe, engine, avionic and equipment manufacturers including subsidiaries of U S companies

House Unit Approves Kennedy Science Plan

Washington—House Government Operations Committee last week approved President Kennedy's plan to establish an Office of Science and Technology to coordinate government research programs

The House action came in the form of a vote against a resolution to disapprove the plan to reorganize the administration of government scientific programs The resolution now goes to the House floor where it also probably will be rejected No similar resolution is pending in the Senate The plan takes effect automatically if Congress does not disapprove it

Elmer B Staats, deputy director of the Budget Bureau, told the House Executive and Legislative Reorganization Subcommittee that the reorganization would provide the President with a more adequate science staff and strengthen the administration of the National Science Foundation He said the government, through better coordination of science programs, would save far more than the $100,000 to $150,000 additional cost involved in setting up the new office

Under the reorganization, the current post of presidential science adviser would become the director of the new science office President Kennedy will appoint the director, and presumably will name Jerome B Wiesner, present presidential science adviser to the $21,000 a year position

The director of the new Office of Science and Technology will both advise the President and be answerable to Congress regarding federal science programs He also would take over some of the duties of the National Science Foundation including the evaluation of federal scientific research programs

News Digest

Production of all first stage engines for Titan I has been completed at Aerojet-General's Sacramento, Calif liquid rocket plant Production of all second stage engines is scheduled for completion by the end of this month and company already has converted its manufacturing facility to accommodate production requirements for Titan 2 engine production

White House intervened last week to avert an Air Line Pilots Assn strike against Pan American Both parties agreed to submit a dispute over crew complement to final and binding arbitration Arbitration board was directed to return an award by May 20

First successful three stage firing of an Army Nike Zeus anti-ICBM from Pt Mugu, Calif was conducted last week in the tenth successful test launch at the Pacific Missile Range base There was no target or simulated intercept mission

Umbaugh Aircraft Corp won dismissal last week of a suit filed in Federal Court, Tampa, Fla on the grounds that the petitioner, Al Waddell Jr., of Houston, Tex., was not a judgment creditor Suit also was directed against Raymond E Umbaugh and others associated in the U-18 gyroplane project Waddell had asked a temporary injunction preventing Umbaugh from disbursing funds and appointment of a receiver Waddell also is a party to a suit involving Umbaugh in a Baltimore, Md., state court (AW Apr 9, p 29) Maryland hearings will resume this week

Rohr Corp., Chula Vista Calif., will build landing gear pods and doors for the C-141 turbofan jet transport now under development for USAF by Lockheed Georgia Co Subcontract for $12 5 million covers the first five planes Rohr also has the C-141 jet engine pod subcontract

Civil Aeronautics Board examiner has denied the requests of the Transport Workers Union and Flight Engineers International Assn., supported by International Assn of Machinists, for a stay of the American-Eastern airlines merger now before CAB

Norden Division of United Aircraft will be headed by John N Phillips, engineering manager since 1956 of General Electric's Radio Receiving Department, Utica, N Y He will become general manager May 7, succeeding Robert A Aspinwall, now UAC assistant treasurer

Airline Competition Shifts Due in Canada

Politics play key role as deficit-ridden carriers face new realignment of domestic routes and traffic.

By L. L. Doty

Montreal—Canada's two major airlines, staggered by deficits and an unsuccessful year-long experiment with low fares, are headed for another realignment of their competitive positions on domestic routes (AW Jan 9, 1961, p 42)

Meanwhile, the two carriers—Canadian Pacific Airlines and Trans Canada Air Lines—have become embroiled in a minor price war, a direct result of the low tariff test which proved that, while one road to an expanded market is through the low-fare route, it is not necessarily the direct road to a profitable operation State-owned Trans Canada, which initiated the rate experiment on Jan. 2, 1961, experienced a 21% traffic increase last year but, in the process, suffered the biggest net loss in its 25-year history—$6 4 million

Privately-owned Canadian Pacific, which promptly matched Trans Canada's lower rates last year, lost $7 6 million in 1961 and, despite an increase in revenue passenger miles, reported a decrease of almost 2% in gross revenues generated on its domestic system.

Earlier this year, Trans-Canada concluded that the only way it could prevent more losses was to hike its tariff level, and on Apr 1, increased economy rates from $1 to $16, depending on the length of the trip Canadian Pacific chose to maintain the lower prices, which launched the rate battle, thus presenting two opposing operating philosophies which will force the government to readjust the competitive patterns of the two companies

It is well known here that Prime Minister Diefenbaker's Conservative government wants to strengthen CPA as a pre-election demonstration of its firm endorsement of the free-enterprise system It was unsuccessful in granting the airline authority to compete with TCA on the transatlantic route after Great Britain refused to give CPA traffic rights in London

The next anticipated government move will be the expansion of CPA's traffic rights on the transcontinental route By offering lower fares, CPA will undoubtedly drain traffic from TCA It will then be in a position to show that traffic demands exceed capacity and, therefore, the restriction which prevents CPA from operating more than one round trip transcontinental flight daily should be lifted.

Feeling is high here that, once CPA builds up waiting lists for its single transcontinental flight, the airline will immediately ask for an easing of restrictions on the route. And there is little doubt that the Conservative government will immediately grant such a request

Meanwhile TCA is determined to stick to the higher fares It can only point to its losses, which—as a state owned carrier—are borne by the taxpayer, and emphasize that its former profit record will be restored only through the higher fares. Yet, TCA is in no position to absorb losses on the transcontinental route

Because it is Canada's national airline, it is required to operate a number of lightly-traveled routes at losses which must be offset by earnings from high-density routes TCA regularly showed a profit from 1951 up to 1960, when CPA was first granted authority to operate domestic routes, thus breaking TCA's former monopoly within Canada In 1960, TCA lost $2 6 million

If the Liberal Party ousts the incumbent Conservatives in this year's election—which is considered a good possibility—chances are strong that competition between the two carriers will be virtually eliminated In addition, a drive to merge the two companies into a single, nationalized airline is more than a remote possibility under a Liberal regime

Thus, the future of Canada's air policy now rests on the nation's political climate There can be no question that CPA will flourish under Conservative rule When it was decided to operate Canada's major routes under the competitive system, it was clearly stated that the Air Transport Board would review the full consequences of competition at the end of two years

No such review has taken place and there is no sign that any is planned under the Conservatives If the Liberal Party should gain power however a full review and thorough probing of the competitive policy can be expected

Some aviation officials here favor a controlled division of traffic between the two carriers, with TCA carrying a large majority of Canadian passengers but with CPA getting enough to justify an expansion of its routes and flight frequencies within Canada

The fare squabble is expected to force a decision on the competitive issue earlier than had been expected CPA with a limited flight frequency, probably will not encounter any severe losses from the low fares since demand will be sufficient to bolster load factors to a level well above the break-even point TCA, on the other hand, under its requirement to provide a widespread pattern of daily schedules, cannot produce an over-all load factor high enough to surmount the break-even point

Failure of the TCA low level tariff to produce a profit is attributable to several miscalculations The TCA fares were based on a projected cost curve which anticipated a drop in unit operating costs and an accompanying increase in passenger traffic

Unit costs did drop sharply as new and larger turbine aircraft took over about 89% of the total transportation work load And passenger traffic rose 20% over the 1960 volume

Paradoxically however, average unit revenues plummeted from the 1960 level of 6 24 cents per passenger mile to 5 74 cents, substantially below the 6 09 cents mark that had been established in the forecast based on the projected cost curve

In its original projection, TCA forecast that revenues would exceed costs on stage lengths beyond 600 mi which, on the basis of anticipated traffic forecasts would provide a sufficiently large profit margin to enable the carrier to show over-all earnings Unfortunately, the breaking point for profitable operations proved to be not 600 but 900 mi

In fact, TCA's 1961 experience proved that the lower fares tempted passengers into traveling over the lower yield, long-distance routes Medium haul high-yield traffic declined simultaneously In 1961, the average domestic passenger trip length on TCA routes climbed to 566 mi from 498 mi in 1960

Another factor in pulling down average revenue units was the unexpected mass switch from first-class to economy classes First-class load factor fell from 66 4% in 1960 to 60 3% in 1961 Economy load factor, during the same period, climbed from 66.5% to 68 7%, and the trend is continuing

Total of 79% of all TCA's North American passengers traveled economy class in 1961 compared with 34% in 1960 The forecast had predicted 69% for 1961 At present, the economy class volume is moving past 80% of the total volume The carrier had also expected that some of its new traffic generated by the lower fares would be attracted to the first-class section This apparently did not occur since the vast majority of new long haul passengers turned to the economy class

The new fares narrow the gap between the price of economy and first class accommodations which, it is hoped, will stop the diversion This has been achieved by raising all fares between $1 and $16 and by reducing some first-class fares, particularly on long-haul routes

The tariff revision is expected to increase TCA's 1962 revenues by 3% and raise the unit return per passenger mile to 5 9 cents

CPA attributed a part of its loss to the fare reductions, but also added as causes the transitional costs of introducing Douglas DC-8 transports on its routes insufficient traffic to fill expanded seat capacity and the restrictions on its flight frequencies

FAA Engine Directive

Washington—Operators of General Electric CJ805 23 turbofans have been told by a Federal Aviation Agency airworthiness directive to replace a long list of parts every 200 cycles "to preclude low cycle fatigue failure" of the engine's fan, a combination blade and bucket

A cycle involves starting the engine, running it at takeoff power and shutting it down, whether on the ground or in flight An aerial restart also is a cycle The number of cycles an engine accumulates is not necessarily related to its time since overhaul.

Parts removed from the defective CJ805 23s are to be replaced with others described in a GE alert bulletin forwarded to all operators of the engine

Idlewild Noise Probe

Washington—Federal Aviation Agency last week began what it describes as an "intensive evaluation" of noise abatement procedures formulated for use at Idlewild Airport.

FAA aircrews last week flew an agency Boeing 707 through all anti-noise takeoff and approach procedures authorized at the terminal Oscar Bakke, assistant FAA administrator, said the flights "would indicate what compromises, if any, pilots are compelled to make with safety in order to remain with the noise levels that would be tolerated by adjacent communities," according to an agency announcement. (See story p. 43.)

Principal emphasis, FAA said, "will be placed on maneuvers which were known to be, or which might have been, involved in the crash of the Los Angeles-bound (American Airlines) Boeing 707 in Jamaica Bay on Mar. 1." Should a link between this accident and noise abatement be uncovered, FAA's eastern region will effectively reverse FAA Administrator N E Halaby, who has stated that the two were not related

About 40 members of Congress and civic leaders from nearby communities were invited to participate in the first phase of the evaluation program by the agency

First VC.10 Transport Rolls Out

First Vickers-Armstrongs VC 10 four-jet transport was rolled out of its Weybridge Hangar Apr 15 and last week had started resonance tests prior to first flight in late May or early June. Preflight tests also will include about 80 hr ground running of the four Rolls-Royce Conway 42 powerplants Mockups have been completed for first Vickers' Super VC 10, the 13th and subsequent airplanes for British Overseas Airways Corp., and metal will be cut soon for production. Super VC 10 will have thrust reversers fitted on all four Rolls-Royce RCo 43 Mk. 550 engines. VC 10 has reversers on two outboard engines

Probes Hindered

New York—Civil Aeronautics Board accident investigators are hampered by barriers to information, the reluctance of companies to answer questions that might have legal ramifications, according to Melvin N. Gough, director of the Bureau of Safety of the Civil Aeronautics Board

It is a difficult task for engineers to talk only to lawyers, Gough said. The investigator's job, he emphasized, is to determine the facts and find the cause of an accident, not the responsibility for it Product liability, he indicated, was a factor in the tendency to refer questions to legal advisers

Northeast Control Case Parties Agree to Expedite Procedures

Washington—Parties in the Hughes Tool Northeast Airlines Control Case last week agreed to procedural dates designed to expedite Civil Aeronautics Board's decision.

Examiner Merritt Ruhlen set the date for briefs to the examiner at 10 calendar days after the close of the hearings following release of the examiner's initial decision, parties will have 14 calendar days to file petitions for review and an additional seven days for parties to answer these petitions. The case then goes to the Board for decision in which case the Board will set further procedural dates.

Northeast hinged its approval of the dates on the condition that the hearing be ended by Apr. 20. Northeast told the examiner that if the hearing should continue beyond that date it would have to take some other action to speed a decision.

Presumably, the airline meant it might again ask for certification of the record to the Board as allowed by the Administrative Procedures Act. Under certification, that examiner would send the record directly to the Board for decision and the Board would set its own procedural steps and dates.

After Northeast's first request for certification of the record, Hughes Tool filed an answer outlining what approval it wanted from the Board before lending more money to Northeast.

Specifically, Hughes Tool said it would not risk more money on Northeast unless CAB made a clear-cut decision finding its previous control of Trans World Airlines and its prior dealings with Northeast not adverse to the public interest. In addition, Hughes Tool wants CAB to rule that its past relations with the two airlines were not inconsistent with Federal Aviation Agency and CAB orders.

CAB Endorsement

Some observers in the case feel such an endorsement by CAB of Hughes Tool's past control of TWA (AW Apr. 16, p. 47) and relations with Northeast might go far toward helping the company regain control of TWA.

Hughes Tool said that without CAB approval of control it could not formulate a plan to revitalize Northeast. Lacking approval, the company said, it would be unable to deal with creditors or management.

Another point to be considered before a plan can be worked out for Northeast is evaluation of a possible merger with TWA or some other airline and prospects for its approval by CAB, the firm said.

In addition, it said it would have to consider the impact of pending CAB action on New England regional airports (AW Apr. 9, p. 45), and possible CAB rulings in the Florida Renewal Case (AW Jan. 15, p. 42). Hughes Tool said that while Northeast's acquisition of permanent operating authority on its Florida routes was not a prior condition to formulating a plan for the airline, it is a factor that must be considered. The company said it also would have to assess what it called "unfair" competition by Eastern Air Lines.

Hughes Tool Stock Seizure Ordered

Trans World Airlines last week obtained a Delaware Chancery Court order to sequester all stock owned by Howard Hughes in Hughes Tool Co. A Wilmington attorney, Jacob Kreshtool, was appointed by the court to carry out the seizure.

TWA asked for the sequestrator to hold the stock to compel the appearance of Hughes as part of a new suit filed by TWA seeking $35 million in damages from Hughes.

The suit's primary aim is to bring Hughes "out of hiding," according to the airline. TWA alleges that it has been unable to find Hughes in a search begun last October. Search is in connection with an anti-trust suit by TWA which was filed in New York last summer (AW Aug. 14, p. 42).

Damages sought in the anti-trust suit total $115 million. The $35 million is in addition to this total. The Delaware suit, like the anti-trust suit, alleges irreparable damages to TWA by Hughes and Toolco and asks injunctions against defendants' attempting to exercise control of TWA or interfering with or harassing the airline.

In an accompanying affidavit, TWA counsel cites testimony in the Toolco-Northeast Control Case to the effect that Toolco's net worth is more than $250 million, its net current assets more than $20 million.

TWA claims it has spent thousands of dollars in the search for Hughes, with the participation of numerous law firms and private investigators. It was learned that Hughes has frequented several locations in this country and elsewhere, but he could never be found at any of these locations, it is alleged.

The affidavit cited statements by Hughes' counsel in the New York litigation in which counsel acknowledged that Hughes was not available to him and had not been for some time, and that there was nothing counsel could do about it.

In the New York litigation last week, the court was considering a TWA motion to dismiss a counterclaim filed against the airline by Toolco last February (AW Feb. 19, p. 47).

Atlantic Group Rates Win CAB Approval

Washington—Civil Aeronautics Board gave top priority to solving the excess seat capacity on North Atlantic routes last week in a 3-2 approval of International Air Transport Assn. group fare rates (AW Apr. 16, p. 43).

Emphasizing the need to develop a low fare, mass market of air travel over the North Atlantic and its concern over the economic plight of the certificated carriers, the majority decision found that the benefits of the group fare to both the airlines and public should not be denied because of objections filed by supplemental and cargo carriers. The majority also suggested that certificated airlines further improve their transatlantic load factors and profits by developing new excursion fares of longer duration and with less seasonal restrictions.

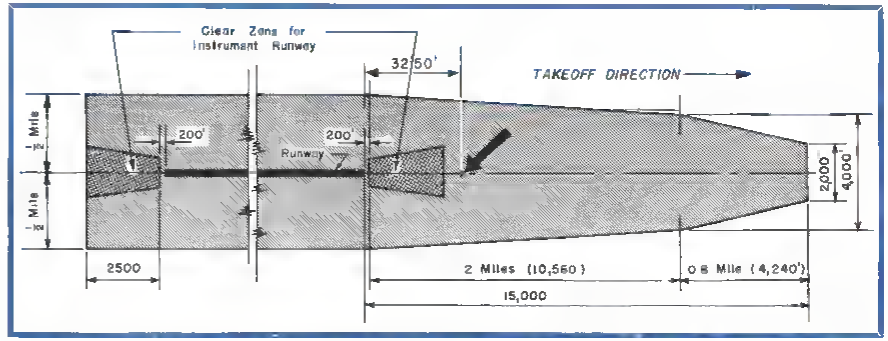
Vice Chairman Robert T. Murphy and Member G. Joseph Minetti agreed on the need for the group fare but criticized the majority's refusal to permit its use by cargo and supplemental airlines.

The fare agreement becomes effective on May 31 and expires on May 31, 1963. It provides for reduced round trip fares to groups of 25 or more persons traveling in economy class on the North Atlantic at an estimated rate reduction of 38% from the normal round trip economy fares.

New York Airways To Purchase Fifth V-107

New York—New York Airways plans to go ahead with the purchase of five Boeing-Vertol 107 helicopters although only four are covered by guaranteed loans and Civil Aeronautics Board says operation of the fifth aircraft will not be eligible for subsidy.

The Board accepted New York Airways' contention that terms of a five-ship contract were more favorable than terms of a four-ship contract, and so authorized the airline to go ahead with the contract for five. But it specified that there would be no claims for subsidy involving the fifth ship.



SUGGESTED PLACES OF PUBLIC ASSEMBLY should be barred from shaded area surrounding runway which would be reserved for non-residential development. Diagram and related dimensions were prepared by FAA and forwarded to Federal Housing Administration in September, 1960, to serve as a guide in granting mortgage loans. Distances are to abate noise generated by Boeing 707s or Douglas DC-8s equipped with either JT3 or JT4 turbojets. Diagram represents only FAA criteria for community anti-noise zoning. Approximate location of house in the Griggs Supreme Court case is marked by the large arrow.

Report on Trunklines' Noise Dilemma: Part 2

Opinions Vary Widely on Noise Solution

By David H. Hoffman

Washington—If airline pilots take a tough stand against tightening in-flight anti-noise procedures, an antidote for the unwanted sound of turbojet engines must be found elsewhere. But the Federal Aviation Agency, Air Transport Assn. and the Airport Operators Council all have differing definitions of "elsewhere."

Speaking through the National Aircraft Noise Abatement Council (NANAC), ATA has sought to remind the U.S. public of the already substantial investment in sound suppression made by member airlines. NANAC—which is composed of ATA, Air Line Pilots Assn. and Aerospace Industries Assn.—also works under the theory that an airport neighbor who understands the nature of noise will be less annoyed by it.

Higher Priority

The airport operators, by contrast, see greater urgency in the problem and thus accord it higher priority. Many favor reducing noise by restricting airline operations at night, specifying use of preferred runways and setting certain maximum aircraft weights. These operators aim to make the source of noise more remote, rather than curb the sound itself.

In its most recent approach to the problem, FAA has placed top emphasis on zoning property near airports. To date, the only federal standards a local political unit can use to erect a protective buffer of pre-zoned land around a proposed airport are found in an FAA pamphlet called "Planning Series Item No. 3" dated Sept. 2, 1960.

The authors of this document relying upon a paper published two years earlier by Boeing's transport division plotted the sound pressure level contours generated by a JT3-powered 707-120 on takeoff. Within a cartridge-shaped area that extends from the end of the runway to a point 15,000 ft. away, where the jet is presumed to be at 1,500 ft., FAA would bar construction of noise sensitive developments.

Updating Criteria

But the agency is careful to point out that its planning guide is to apply only to the 707 with either JT3 or JT4 engines, or to the DC-8. To update these criteria, the agency contracted with an acoustical consulting firm known as Polysonics Inc., which is developing similar noise contours for 16 common types of turbojet, piston and rotary wing aircraft.

When Polysonics completes its research, FAA plans to award another contract with its goal the merging of military and civil aircraft noise criteria. First phase of this project was to have been completed late last year.

Concurrently, FAA and the National Aeronautics and Space Administration are sponsoring a project aimed at developing a better unit than the perceived noise decibel to measure how irritating noise can be to the average person. A $100,000 contract for this purpose was awarded last July to Bolt Beranek and Newman, the acoustical engineering firm that defined perceived noise decibel for the Port of New York Authority.

FAA thus far has refused to base noise standards on the PNDB, contending that it fails to consider a jet approach in which compressor whine rather than sound volume is the prime irritant. The PNDB, FAA points out, also was developed by sound juries that scientifically could not weigh the irritating qualities of duration, repetition rates and pure tone components in sound. In addition, there is some evidence to indicate that even the turbofan engine is not an unmixed blessing, for the whine of its fan during an idle thrust approach has been held responsible for a number of noise complaints. But something better than the PNDB should be used to measure it, FAA feels.

Sonic Data

Over the next three years, this pilot FAA-NASA project is designed to produce some of the sonic data required by the civil supersonic transport program.

Perhaps FAA's most effective tool to ensure that new airports never take property through the generation of noise is the federal airport aid act. Under this law, operators seeking to acquire easements through the airspace above nearby property have received federal

money through FAA. But such easements are required under FAA standards to protect the aircraft from obstructions that might penetrate its approach plane, not to protect those on the ground from the aircraft's noise.

To date, FAA reports, the agency has not invested in any specific project that entailed buying extra property or extra easements merely to dampen sound. FAA sources also expressed doubt that operators ever asked for this type of aid. Should operators apply for it, the agency feels it has authority under the act to match funds spent for anti-noise easements.

Cole Morrow, director of FAA's new Airport Service, told AVIATION WEEK that heavy emphasis would be placed on adequate site acquisition when airport projects come up for approval in the future. If an earner airports are subtracted from the U. S. total, two out of each remaining three are privately owned, Morrow said. The expanding suburbs, he believes, endanger this national network of smaller airports, and as a result, FAA will actively encourage public purchase of what it calls "essential" private airports.

The Griggs case noise ruling (AW Apr. 16, p. 36) seems to ensure that the money available for site and airport acquisition in the $75 million-a-year federal program will not accomplish as much for aviation as it would have before the case.

On Mar. 5, in Griggs vs. County of Allegheny, the U. S. Supreme Court ruled that if a plaintiff can prove noise renders his property unfit for a natural use, the airport operator should be the one to compensate him. Two justices, however, held in dissent that it was the federal government—not the airport operator—who should pay the plaintiff.

Argument Rejected

Both Allegheny County and the State of Pennsylvania petitioned the court to reconsider, arguing that the case generated undue confusion, that it had an "adverse effect" on safety programs and that the dissenters were correct in their interpretation of the law. But this argument was flatly rejected by the court last week when it refused reconsideration.

Even FAA acknowledges that its approach to sound suppression has some inherent drawbacks. First, no subdivision of the federal government can actually zone land around an airport built on another's property. FAA can and does recommend that Federal Housing Administration and Veterans Administration refuse to underwrite mortgages on noise sensitive developments near airports.

If it did acquire zoning powers, FAA still could not re-zone pre-existing structures. This same restriction applies to local political bodies. At best, therefore, zoning can be used to protect airports before they are built or if they stand on vast expanses of undeveloped land.

The second force handicapping FAA efforts to reduce noise many believe to be self-imposed. This is the agency's firm insistence that it lacks direct legal authority to regulate noise levels in the vicinity of an airport. FAA air traffic rules according to Halaby, may be used to keep sources of noise away from the people but not set an upper limit on the volume of noise itself.

Port Authority Action

But this is exactly what the Port of New York Authority has done despite the constitutional doctrine that enjoins the states from restricting interstate commerce. When FAA failed to include the Port Authority's 112 PNDB noise ceiling in Special CAR 442 which gave regulation within little more than the Port's pre-existing preferential runway system, the Port was obviously frustrated. It said then:

"The proposed rules fail to recognize that an truly effective program of noise abatement must place actual limits on the amount of noise that a community may be asked to tolerate." The bi-state agency went on to recommend that airlines be required to limit the weight of their aircraft when such action was necessary to gain a steep climb gradient and thus hold down noise.

The Port Authority is a member of the Airport Operators Council, which since the Griggs case has been debating whether to recommend that the Port's singular assessment of its regulatory power be used as a model by other operators. Under 1951 policy, the Port has held that no jet or turboprop aircraft may land or take off at one of its terminals without permission.

E. Thomas Bunnard, executive vice president of AOC, feels that if the Griggs case is interpreted broadly in subsequent litigation the cost of operating an airport will be increased for additional property must be purchased. The burden of paying a portion of this cost increase, he said, probably will be passed on to the airlines.

If airlines would renew their interest in turbofan retrofits and high-lift devices much of the problem could be eliminated, Bunnard told AVIATION WEEK. Such a combination, he said, would enable the steep gradient approaches and departures that would help remove noise from the people who complain of it.

A majority of airport operators apparently feel that as landlords or lessors of terminals, they are empowered to impose reasonable rules on their airline tenants to ensure nuisances are not committed. Jet fleets now in use dictate that such assurance can be had only by controlling the gross weight of the aircraft, the time of takeoff and the runway to be used, the operators say.

Airport operators generally feel that the two dissenting justices in the Griggs case were correct in holding that the federal government, not the airport operator, had taken Griggs property. They also hope that Congress shares this view. If it does, legislation now being drafted can be expected to pass, thus shifting noise liability.

Operators of the larger terminals also favor legislation that would give FAA clear authority to prescribe maximum or acceptable noise levels, compel the manufacturers to build this performance into their product and force the airlines to operate their jets according to such criteria. Draft legislation that would accomplish this goal is being prepared.

Still another avenue being explored by some airport operators entails an amendment to the federal urban renewal laws that would make money available to purchase land in certain areas adjacent to airports. Land thus acquired would be re-sold with the restriction that it be used only in a manner compatible with the local airport.

If the Griggs rule generates any quantity of lawsuits, airport operators also feel that their state legislatures should enact laws requiring a complainant to give notice when he is annoyed by noise and intends to sue. Without such notice within 48 hr. after each offensive flight, the complainant would be barred from suing the airport operator. Draft legislation now is in the process of presentation to several state legislatures.

Airline Opposition

Airlines obviously will oppose most or all of these measures. While the maneuvering continues, ATA says in its behalf that as of January U. S. airlines had invested $73 million to equip 325 turbojet aircraft with sound suppressors. Weight and drag of these devices equals about $10,000 per month per jet in lowered efficiency and lost payload. ATA maintains. On the basis of these figures, noise abatement costs now total approximately $36 million per year for the industry.

In addition, the extra minutes consumed by noise abatement detours on landing and approach must be considered cost items. And at least a portion of American Airlines' $50 million investment to retrofit its entire 707-120 fleet with fan power must be listed under anti-noise investment.

(This is the concluding article of a two-part series on airport noise problems. The first article appeared in AVIATION WEEK *Apr. 16, p. 36.)*

U.S. Domestic, International Airline Operating Revenues and Expenses—1961

(In Thousands of Dollars)

	Operating Revenues							
	Passenger	U. S. Mail	Foreign Mail	Cargo	Charter	Other & Incidental	Federal Subsidy	Total
DOMESTIC TRUNKS								
American	357,629	8,726		33,357	2,195	2,531		414,832
BranIff	70,209	1,930		4,425	817	224		77,605
Continental	58,233	1,239		2,791	194	539		62,996
Delta	143,385	2,962		7,922	335	648		155,252
Eastern	242,027	5,850		12,419	16	1,677		261,989
National	66,549	1,552		4,778	950	686		74,515
Northeast	48,012	722		1,985	84	326		51,129
Northwest	62,235	2,014		4,612	234	2,889		71,984
Trans World	250,296	5,963		17,523	1,886	3,980		279,648
United/Capitol	463,211	16,906		33,952	1,577	1,631		517,277
Western	54,835	1,172		2,142	698	294		59,141
Trunk Total	1,926,821	48,090		126,166	8,986	15,425		2,026,368
INTERNATIONAL								
American	5,377	34	45	802	31	244		6,533
BranIff	9,151	395	151	1,152	874	69		11,792
Caribair	3,634	38	1	217	50	68		4,008
Delta	1,315	8	7	121		1		1,452
Eastern	30,949	709	26	1,718		(11)		33,391
Mackey	1,693			77	105	36		1,911
National	56	1		3		1		61
Northwest	23,736	8,460	1,227	3,831	1,131	743		39,128
Panagra	16,112	782	643	3,741	84	1,459		22,821
Pan American	333,842	33,382	5,323	49,907	29,667	5,933		458,054
South Pacific	615	6	4	23		(8)		640
Trans Caribbean[1]	5,021		1	553	551	374		6,500
Trans World	61,862	8,928	1,165	7,570	2,079	1,666		83,270
United	24,560	1,255		854		351		27,020
Western	4,902	42	16	130		21		5,111
Intl Total	523,025	54,040	8,609	70,699	34,572	10,947		701,892
LOCAL SERVICE								
Allegheny	13,142	241		838	84	70	6,351	20,800
Bonanza	5,699	49		169	9	42	3,284	9,252
Central	3,695	141		241	53	49	3,891	8,070
Frontier	7,234	208		474	47	98	6,825	14,886
Lake Central	5,267	131		335	52	17	3,940	9,742
Mohawk	12,656	224		518	375	218	4,309	18,310
North Central	15,632	435		928	64	103	8,032	25,194
Ozark	8,075	213		551	65	87	4,273	13,264
Pacific	6,389	164		198	361	40	3,943	11,095
Piedmont	8,386	137		348	187	208	4,446	13,712
Southern	5,669	216		328	60	30	4,374	10,697
Trans Texas	5,331	157		355	91	44	4,023	10,001
West Coast	6,647	126		227	41	47	5,245	12,333
Local Total	103,622	2,448		5,518	1,459	1,373	62,936	177,056
ALASKA & HAWAIIAN								
Alaska Airlines	2,972	645		649	2,231	270	1,953	8,720
Alaska Coastal	1,022	118		141	45	37	765	2,128
Aloha	4,895	27		79	13	233	293	5,540
Cordova	221	131		171	333	13	441	1,310
Ellis	640	53		77	19	32	432	1,253
Hawaiian	6,747	45		973	247	130	404	8,546
Kodiak	197	11		29	77	2	32	349
No. Consolidated	1,116	807		545	129	46	1,724	4,367
Pacific Northern[2]	7,693	1,133		1,557	21	143	1,756	12,303
Reeve Aleutian	1,663	564		505	280	58		3,070
Western Alaska	88	21		13	66	2	158	348
Wien Alaska	1,234	824		489	669	28	2,798	6,042
Alaska & Hawaiian Total	28,488	4,379		5,228	4,130	994	10,757	53,976
HELICOPTERS								
Chicago	1,423	49		8	1	1	1,870	3,352
Los Angeles	248	153		163	1	3	1,083	1,651
New York[2]	1,080	48		77	64	11	2,307	3,587
Helicopter Total	2,751	258		248	66	15	5,260	8,590
CARGO & OTHER								
AAXICO					4,148	340		4,488
Aerovias[2]				479	2,219	48		2,746
Avalon	450	18		8	38	1		515
Flying Tiger		105		10,535	21,556	225		32,421
Riddle		129		4,081	19,430	66		23,706
Seaboard[2]		5,033	154	7,779	7,511	76		20,553
Slick					11,775	217		11,992
Cargo, etc. Total	450	5,285	154	22,882	66,677	973		96,421
INDUSTRY TOTAL	2,485,157	115,432	8,763	230,681	115,990	29,427	79,953	3,864,303

[1] Year Ending Sept 30, 1961 [2] Preliminary Report

(In Thousands of Dollars)

	Operating Expenses								Operating Profit (or Loss)	Net Profit (or Loss)
	Flying Operations	Maintenance	Passenger Service	Aircraft & Traffic Servicing	Promotion & Sales	General & Admin.	Deprec. & Amort.	Total		
DOMESTIC TRUNKS										
American	104,435	87,033	32,198	66,221	45,995	18,193	39,666	395,741	19,091	7,449
BranIff	21,414	15,580	6,090	13,513	8,025	2,834	6,310	73,766	3,839	1,968
Continental	16,844	10,496	5,120	7,232	6,311	2,923	9,153	58,079	4,917	1,121
Delta	39,718	31,062	11,246	23,393	16,233	3,988	16,145	141,785	13,467	5,512
Eastern	88,269	51,905	21,434	42,007	33,482	10,521	36,020	283,638	(21,649)	(10,002)
National	21,947	14,385	5,148	10,947	9,440	1,883	11,201	74,971	(456)	(2,258)
Northeast	20,406	12,909	4,239	9,540	6,228	1,625	4,427	59,374	(8,245)	(9,447)
Northwest	20,519	12,650	5,490	8,654	7,209	3,741	12,602	70,865	1,119	85
Trans World	78,060	57,580	22,809	42,260	31,136	13,645	44,384	289,874	(10,226)	(24,804)
United/Capital	145,327	97,679	38,761	94,856	53,793	19,943	63,785	514,144	3,133	(4,492)
Western	17,581	8,530	4,276	7,658	7,702	2,874	9,119	57,740	1,401	650
Trunk Total	574,520	389,809	156,811	328,301	225,554	82,170	252,812	2,019,977	6,391	(34,566)
INTERNATIONAL										
American	1,870	1,022	483	1,131	766	367	1,107	6,746	(213)	(171)
BranIff	3,544	2,156	1,081	2,293	1,774	865	1,413	13,126	(1,334)	(682)
Caribair	760	622				2,060	128	3,570	438	370
Delta	644	560	173	504	421	112	309	2,723	(1,071)	(500)
Eastern	12,610	5,359	2,386	4,650	2,579	1,051	3,254	31,889	1,502	459
Mackey	533	455				862	154	2,006	(95)	(130)
National	17	19	5	30	22	2	16	111	(50)	(400)
Northwest	8,750	4,603	1,689	3,791	4,764	2,352	4,516	30,465	8,663	3,578
Panagra	5,105	4,561	1,420	3,065	4,123	1,616	2,477	22,367	454	161
Pan American	114,905	69,416	34,798	69,150	69,975	17,939	59,090	435,273	22,781	7,268
South Pacific	429	256				586	31	1,302	(662)	(721)
Trans Caribbean[1]	2,084	1,378	398	874	1,027	642	563	6,966	(466)	(314)
Trans World	21,518	11,911	6,100	11,292	16,105	4,010	13,917	84,853	(1,583)	(13,710)
United	5,767	3,020	1,866	1,935	3,562	1,129	2,935	20,214	6,806	2,990
Western	1,282	676	403	472	608	260	862	4,563	548	209
Intl Total	179,820	106,014	50,802	99,187	105,726	33,853	99,772	666,174	35,718	(1,794)
LOCAL SERVICE										
Allegheny	5,716	4,640	963	4,549	1,686	912	1,534	20,002	498	(24)
Bonanza	1,996	1,608	371	1,659	935	791	715	8,075	1,177	456
Central	2,334	1,497	383	2,424	579	445	202	7,864	206	101
Frontier	4,427	2,727	752	3,629	870	775	962	14,142	744	308
Lake Central	3,070	1,766	532	2,467	798	567	430	9,650	92	(61)
Mohawk	4,635	3,943	769	3,984	1,919	924	1,329	17,503	807	330
North Central	7,028	5,378	1,220	7,025	1,589	932	1,110	24,282	912	1,855
Ozark	3,622	2,673	645	3,510	879	727	472	12,528	736	339
Pacific	2,870	2,504	399	1,827	958	747	855	10,160	935	317
Piedmont	3,766	2,735	651	3,420	820	590	640	12,622	1,090	473
Southern	2,914	2,067	580	2,859	730	534	424	10,108	589	204
Trans Texas	2,961	2,258	504	2,445	810	516	310	9,804	197	67
West Coast	3,332	2,198	619	2,563	941	726	603	10,982	1,351	469
Local Total	48,671	35,994	9,388	42,361	13,316	9,186	9,586	167,722	9,334	4,894
ALASKA & HAWAIIAN										
Alaska Airlines	3,235	1,680	528	1,734	681	658	657	9,173	(453)	(312)
Alaska Coastal	608	644				735	103	2,090	38	14
Aloha	1,106	1,198	156	807	937	568	555	5,327	213	(154)
Cordova	383	328				513	112	1,336	(26)	(39)
Ellis	353	374				535	67	1,329	(76)	(54)
Hawaiian	1,957	1,669	236	1,514	1,244	972	537	8,129	417	267
Kodiak	112	96				130	59	397	(48)	(9)
No. Consolidated	936	970				1,336	283	3,525	842	311
Pacific Northern[2]	3,774	2,052	880	2,376	989	797	822	11,670	613	280
Reeve Aleutian	800	667				767	122	2,356	714	401
Western Alaska	104	56				116	41	317	31	25
Wien Alaska	1,550	1,328				1,768	216	4,862	1,180	273
Alaska & Hawaiian Total	14,918	11,062	1,800	6,431	3,851	8,895	3,574	50,531	3,445	1,029
HELICOPTERS										
Chicago	743	1,064				948	481	3,236	116	149
Los Angeles	353	456				691	60	1,560	91	47
New York[1]	840	1,089				1,378	595	3,922	(335)	(163)
Helicopter Total	1,936	2,609				3,017	1,136	8,718	(128)	33
CARGO & OTHER										
AAXICO	1,819	1,182				539	1,048	4,588	(98)	(153)
Aerovias[2]	1,591	522	107	307	71	285	54	2,937	(191)	(209)
Avalon	149	115				271	64	599	(84)	(75)
Flying Tiger	10,925	6,558	957	4,169	1,619	1,723	5,054	31,005	1,416	(3,721)
Riddle	10,328	4,994	680	2,737	653	1,197	2,264	22,853	853	(133)
Seaboard[2]	8,812	5,670	630	3,331	1,342	1,404	3,203	24,392	(3,839)	(3,778)
Slick	5,279	2,016	487	1,062	2	631	1,255	10,732	1,260	1,103
Cargo, etc. Total	38,903	21,057	2,861	11,806	3,687	6,050	12,940	97,184	(683)	(6,963)
INDUSTRY TOTAL	858,788	576,545	220,662	487,906	352,334	143,171	378,820	3,818,228	54,877	(37,433)

[1] Year Ending Sept 30, 1961 [2] Preliminary Report

First Lockheed C-130E Delivered to USAF

First Lockheed C-130F turboprop transport was delivered to Charleston AFB S C recently Primary duty of the C-130E Hercules which will see duty both with the Military Air Transport Service and the Tactical Air Command, is overseas airlift of U. S combat forces The C-130E has increased takeoff weight and carries additional fuel in pylon tanks Range is 1,000 naut. mi. greater than C-130B

Airlines List Officers' Salaries, Expenses

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec 31, 1961, as reported to the Civil Aeronautics Board

United Air Lines—W A Patterson, president $100,000 salary 17,110 shares of common stock **C Barkes,** executive vice president-finance and property $58,000 salary 9,210 shares of common stock **D R Petty,** senior vice president flight operations, $58,000 salary 7,505 shares of common stock **J A Herlihy** senior vice president-engineering and maintenance (died Feb 10 1962) $55,000 salary 5,405 shares of common stock **R E Johnson** senior vice president sales and advertising $51,000 salary 2,566 shares of common stock **D F Magarrell** senior vice president transport services (retired Feb 28 1962) $44,710 salary 4,562 shares of common stock **H F Ahrens** senior vice president and assistant to the president $44,000 salary 2,152 shares of common stock **W C Mentzer** vice president-engineering $44,000 salary 2,994 shares of common stock **V M DeVoursney** executive vice president-administration $42,100 salary 1,378 shares of common stock **C F McErlean** senior vice president-law $41,000 salary 1,068 shares of common stock **G E Keck** executive vice president-operations $39,750 salary 821 shares of common stock **J E Sommermeyer** vice president-flying $39,000 salary 138 shares of common stock **H F Neufer** senior vice president economic planning $38,000 salary 7,731 shares of common stock **J M Hodgson** vice president communications, $35,100 salary 813 shares of common stock 702 shares of common stock in the name of others

O T Larson vice president transportation services $33,000 salary 1,045 shares of common stock **B B Gragg** vice president sales services $33,000 salary 1,052 shares of common stock 204 shares of common stock in the name of others **C M Mason** senior vice president personnel $30,500 salary 19 shares of common stock **R J Merchant,** vice president-sales manager $30,500 salary 728 shares of common stock 372 shares of common stock in the name of others **O C Enge** vice president-passenger services $30,000 salary 2,282 shares of common stock **R E Bruno** vice president-treasurer $30,000 salary **F A Brown** senior vice president transportation services $29,875 salary 454 shares of common stock **D V O'Leary** vice president-purchasing and stores $29,500 salary 1,129 shares of common stock **R M Buddirk** vice president and assistant to the president $28,3[illegible] salary 299 shares of common stock **W F Alberts** vice president-management services and controls $27,280 salary 492 shares of common stock **J F Moore** vice president traffic $26,600 salary 2,385 shares of common stock **D C Meenan,** vice president-facilities and property $25,500 salary 144 shares of common stock **S P Martin** secretary of the corporation and assistant to the president $25,000 salary 3,180 shares of common stock $1,000 debentures **L F Hangel** vice president business economics, $22,200 salary 554 shares of common stock

F A Wood vice president base maintenance $21,000 salary 679 shares of common stock **C E Fenelion** vice president-transportation services $21,735 salary 318 shares of common stock **G B Herms,** controller $20,000 salary 339 shares of common stock **D S Kilarr** vice president-employe development $20,000 salary 383 shares of common stock **W H Whitlock** vice president line maintenance $19,217 salary **M C Ansorge** director $3,000 salary 1,156 shares of common stock $3,000 debentures **F A Bissinger** director $3,500 salary 2,201 shares of common stock **H T Brown** director $3,700 salary 506 shares of common stock **L Cowles** director $3,300 salary 100 shares of common stock **J W Deel** director $3,300 salary 15,587 shares of common stock **T F Gired** director $3,500 salary 803 shares of common stock **P G Hoffman** director $3,300 salary 1,376 shares of common stock $7,000 debentures **F A Johnston** director $3,500 salary 5,525 shares of common stock **J J Mitchell** director $3,300 salary 5,098 shares of common stock **A Nielsen** director $3,700 salary 1,113 shares of common stock $11,000 debentures **A Stauffer** director $1,500 salary 2,250 shares of common stock $10,000 debentures.

Expense figures for United Air Lines officers will be filed later

The following firms were paid $5,000 or more for services rendered during 1961 **Armour Research Foundation of Illinois Institute of Technology** research $10,597; **Arthur Andersen & Co** auditing and related services $142,563; **Rognar Benson** for architecture and engineering $111,771; **Bradbeck Flthrer & Harrison** legal $37,328; **C E I R Inc** professional and technical services $9,937 **Chadbourne Parke Whitside & Wolf** legal services $6,988 **Frank Baire** supervising terminal construction $8,423 **R M Doolie** airport consulting services $9,680 **Height Gardner Poor & Havens** legal services $19,425 **Hardin Hess & Fder** legal services $13,005 **John F Hauler** civil engineer $8,197 **Leigh Fisher & Associates** advisory services $30,154 **Mayer Friedlich Spiess Tierney Brown & Platt** legal services $292,657 **McAfee Bruning Newcomer & Hazlett** legal services $6,442 **G Dittebrider Ollinger** architect engineers services $9,795 **Perkins & Will** architectural services $9,029 **James Francis Reilly** legal services $37,182 **Harold L Sleight & Associates** architectural services $9,761 **Stanford Research Institute** research $68,572 **John R Steelman** consultation $13,000 **Whitford Hart Carmody & Wilson** legal services $8,333 **Covington & Burling** legal services $5,607; **Morris Nichols Arsht & Tunnell** legal services $65,904 **Adair Ulmer Murchison Kent & Ashby** legal services $11,001 **Cleary Gottlieb Stern & Hamilton** legal services, $1[illegible],030 **O'Melveny & Meyers** legal services $5,187 **Serive Stevenson Valor & Roeckl** engineering $25,457

Western Air Lines Inc.—T C Drinkwater president and director $78,312 salary $16,070 expenses 7,000 shares of common stock **S R Shatto** vice president-operations and director $49,340 salary $3,793 expenses 3,901 shares of common stock **M W Landes** vice president service $38,100 salary $2,007 expenses 1,059 shares of common stock **A F Kelly** vice president-sales, $38,100 salary $5,401 expenses 9,734 shares of common stock **J J Taylor,** vice president and treasurer $35,100 salary $454 expenses 2,700 shares of common stock **D P Renda** vice president legal and secretary $33,100 salary $5,008 expenses 1,003 shares of common stock **S Gewirtz** vice president-administration (resigned Mar 17 1961) $5,090 salary $3,000 expenses **G G Broadrr** vice president $29,794 salary $7,843 expenses 1,000 shares of common stock **C J J Cox** controller and assistant treasurer $29,788 salary $986 expenses 1,000 shares of common stock **W C Jennings** assistant secretary $17,000 salary $443 expenses **J W Simpson** assistant secretary $17,000 salary $3,642 expenses 100 shares of common stock **H W Darling** director $500 salary 100 shares of common stock **R J Driscoll Sr** director $500 salary $25 expenses 1,500 shares of common stock **R C Haight** director $800 salary 250 shares of common stock in the name of others **G Lawes** director $200 salary $15 expenses 1,250 shares of common stock **Dr D B McLaughlin** director $400 salary $507 expenses 146 shares of common stock **F W Pauley** director $200 salary 1,850 shares of common stock **I W Pague** director $500 salary $18 expenses 1,345 shares of common stock **B Swim** director $500 salary $230 expenses 23,500 shares of common stock **H Volk** director $600 salary 1,200 shares of common stock **J M Wallace** director $500 salary $104 expenses 649 shares of common stock **A Warden** director $100 salary 497 shares of common stock **S F Woodbury** director $500 salary $382 expenses 139 shares of common stock 888 shares of common stock in the name of others

The following firms were paid $5,000 or more for services rendered during 1961 **Peat Marwick Mitchell & Co** auditing and related services $12,[illegible] **Airport Joint Venture** architectural and engineering services $91,100 **Parker Engineering** engineering services $34,205 **Darling Shattuck Hall & Call** legal services $37,851 **Pogue & Neal** legal services $15,141 **O'Melveny & Meyers** legal services $18,149 **Security First National Bank** transfer agents $10,543 **Chemical Bank New York Trust Co** transfer agents, $8,748

Why does the Mohawk look the way it does?

Why is the Mohawk so blunt and bug-eyed? To afford maximum visibility short of putting men in an open cockpit. This is called "eyeball observation," because the Mohawk is primarily an observation airplane. The pilots can see the same point directly under the airplane from only 37 feet up.

Why is landing gear so bulky? To attain a landing capability or sink speed of 17 feet per second (1020 fpm). If the average airplane landed this hard, it would crush the landing gear. This rugged landing gear gives the Grumman Mohawk unique and exceptional rough field capability.

Why a midwing? When a wing is high on the fuselage, the landing gear is necessarily longer—and weaker. If the wing is low on the fuselage, the propellers are close to the ground and may become fouled on rough fields. This also permits protection of engine and fuel tank from ground fire.

Why is the wing attachment location between the engine and fuselage? If the wing attachment location were outboard of the engines on the Grumman Mohawk, the "wings-off" component would be too wide for towing the aircraft on roads or shipping it by rail.

Why is the landing gear tread so narrow? The Grumman Mohawk's main wheels are attached to the fuselage section rather than the wing. This, plus the wing attachment location, permits easy handling of the fuselage—which is, of course, the heaviest unassembled part.

Why three tails? A single tail would have to be massive and would present an extremely large silhouette. One large tail would also require power controls. Small tails facilitate manual controls, reduce radar reflectivity and permit low ceiling hangar storage and camouflage under low trees.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION Bethpage · Long Island · New York

AIRLINE OBSERVER

► Domestic trunkline revenue passenger miles continued to climb in March with an 11.6% increase over the same month last year. However, a 22.3% increase in available seat miles pulled the monthly load factor to the dangerously low level of 52.24%, a 5.02% drop from March, 1961. At the same time, the steady swing from first-class to coach traffic threatened to depress gross revenues. Coach service last month accounted for 62.3% of all revenue passenger miles, compared with 52.9% in March, 1961. The 11 trunk carriers reported a loss of $8.6 million in February, bringing the total loss for the first two months of 1962 to $14.5 million.

► **Cabin pressure tests have been completed in Hatfield, England, on the second de Havilland three-jet Trident 121 transport and the aircraft is back in hangar for systems installation. The aircraft will roll out in about three weeks.**

► Negotiations for bilateral agreement between U.S. and Austria were recessed over inability to reach agreement on capacity and flight restrictions. Under terms of present interim agreement, U.S. holds fifth freedom rights at intermediate points between New York and Vienna and rights beyond Vienna. Austria is concerned that unrestricted operation of this route by Pan American is draining intra-European traffic from Austrian Airlines and would like to specify schedule volume. Austrians do not plan to seek a U.S. route before another two or three years.

► **Stockholders of both American Airlines and Eastern Air Lines last week gave their unanimous approval to the proposed American-Eastern merger.**

► Pan American World Airways has been waiting word from FAA since late last year on whether it will become the first U.S. carrier to operate jets in 200-ft. ceiling, ½-mi. visibility weather. Last September, FAA said these reduced minimums were entirely feasible, and held out hope they would be granted to carriers that could meet more stringent operating criteria. PanAm satisfied these standards several months ago in flight tests, the agency admitted. But it also said that a decision on Pan American's application, which covers London, Paris, New York and Los Angeles, "was not imminent."

► **Aeroflot, Soviet airline, is preparing to introduce Tu-114 service at more Russian cities soon. Leningrad, Petropavlovsk and Kamchatka are high on the priority list. Since going into regular operation in April, 1961, the four-turboprop Tu-114 transports have been confined to nonstop flights between Moscow and Khabarovsk in eastern Siberia.**

► Caravelle Mk. 10 order by Air France is being held up because of French squabble over engine installation. Sud Aviation, with some political support from the French government, is pressing for a Mk. 10B order which would involve Pratt & Whitney JT8DL engines. Sud is seeking this version to support Caravelle sales in the U.S. and to KLM Royal Dutch Airlines, which prefers the P&W engine. But Air France is holding out for the Mk. 10C version, using Rolls-Royce Avon 533A engines for purposes of standardization.

► **International airlines will seek a law to regulate charges levied against air carriers by governments for use of airports and airways navigational facilities. Special working committee of International Air Transport Assn. in Montreal has estimated that airlines are now paying more than $150 million annually in user charges at world airports, 75% more than in 1958.**

► New airport at Kabul, Afghanistan, being built with Russian assistance, is expected to be completed by the end of the year. A runway capable of handling Soviet Il-18 turboprop transports was activated in 1961, and the aircraft have been flying regularly scheduled flights between Moscow and Kabul since then. Work is now concentrated on the airport's auxiliary facilities and terminal building.

SHORTLINES

► **Bonanza Air Lines** will begin four daily nonstop flights between Los Angeles and Las Vegas on Apr. 29. Round-trip fare will be $26. The new flights will be in addition to Bonanza's regular four flights daily between the cities via intermediate points.

► **Continental Air Lines** reports a general salary increase for all non-contract employes up to the department manager level, effective last month. President Robert F. Six said the increase was in recognition of employes productivity which enabled Continental to earn a profit during 1961. The increase affects 1,300 employes and will cost the company about $375,000 a year.

► **Eastern Air Lines** will begin daily no-frills Air Bus service linking Toledo and Columbus, Ohio and Charlotte, N.C. with Miami Apr. 29. Eastern will use 90-passenger DC-7B equipment originating in Detroit. The Air-Bus fare is 13 to 22% lower than regular day coach service between these cities and Miami. Eastern also plans a daily Boston-Newark-St. Louis Air-Bus round trip flight beginning May 11 using DC-7B equipment in 95-passenger configuration. Fare for this flight will be about 7½% lower than regular day coach service.

► **Richard R. Hough**, vice president-engineering American Telephone and Telegraph Co. and former chairman of the Project Beacon task force, will lead a technical advisory board formed to keep Federal Aviation Agency abreast of developments in science and technology needed to implement Project Beacon recommendations. Other members are Joseph J. George, Eastern Air Lines, Dr. Nathan I. Hall, Hughes Aircraft Co., Prof. Robert Horonjeff, Univ. of Calif., Dr. Carl F. J. Overhage, MIT, and Carlos C. Wood, Sikorsky Aircraft.

► **Seaboard World Airlines** has asked Civil Aeronautics Board for exemption authority to permit direct cargo service between Italy and the U.S. Seaboard World cited a 475% increase in freight boarded in Italy in the last five years.

► **Varig Airlines** of Brazil is studying feasibility of a Rio de Janeiro-Los Angeles-Tokyo route, with an intermediate stop at Wake Island, for possible introduction later this year. Equipment and schedule frequency have not been decided.

Glenn Describes Mercury Orbital Flight

(With the successful launching of Mercury-Atlas 6 from Pad 14 at Cape Canaveral, Fla., at 9:47 a.m. on Feb. 20, Marine Lt. Col. John H. Glenn, Jr., became this country's first astronaut to successfully orbit the earth. On that day, Glenn successfully completed three orbits. The following is a pilot report on that flight prepared by Glenn himself. An AVIATION WEEK report on Glenn's observations appeared in last week's issue, page 30 and in preceding editions.)

Weightless flight was quickly adapted to and was found to be pleasant and without discomfort. The chances of mission success are greatly enhanced by the presence of a human crew in the spacecraft. A human crew is vital to future space missions for the purpose of intelligent observation and actions when the spacecraft encounters expected or unexpected occurrences or phenomena.

Introduction

The test objectives for the MA-6 mission of Friendship 7, as quoted from the Mission Directive, were as follows:

- Evaluate the performance of a man-spacecraft system in a three-orbit mission.
- Evaluate the effects of space flight on the astronaut.
- Obtain the astronaut's opinions on the operational suitability of the spacecraft and supporting systems for manned space flight.

These are obviously broad objectives. Previous papers have described in some detail the operation of the spacecraft systems and, to a degree, man's integration with these systems.

My report is concerned mainly with those items in all three objectives where man's observation capabilities provided information not attained by other means. It is in this type of reporting that a manned vehicle provides a great advantage over an unmanned vehicle, which is often deaf and blind to the new and the unexpected. My report then will stress what I heard, saw, and felt during the orbital flight.

Preparation and Countdown

Preparation, transfer to the launch pad, and insertion into the spacecraft went as planned. The technicians and I had been through the entry to the spacecraft many times.

As with every countdown, short delays were encountered when problems arose. The support for the microphone in the helmet, an item that had been moved and adjusted literally thousands of times, broke and had to be replaced. While the spacecraft hatch was being secured, a bolt was broken and had to be repaired. During this time I was busy going over my checklist and monitoring the spacecraft instruments.

Many people were concerned about my mental state during this and earlier delays which are a part of preparation for a manned space flight. People have repeatedly asked whether I was afraid before the mission. Human always have fear of an unknown situation—this is normal. The important thing is what we do about it. If fear is permitted to become a paralyzing thing that interferes with proper action, then it is harmful. The best antidote to fear is to know all we can about a situation. It is lack of knowledge which often misleads people when they try to imagine the feelings of an astronaut about to launch. During the years of preparation for Project Mercury, the unknown area have been shrunk, we feel, to an acceptable level. For those who have not had the advantage of this training the unknowns appear huge and insurmountable, and the level of confidence of the uninformed is lowered by an appropriate amount.

All the members of the Mercury team have been working towards this space flight opportunity for a long time. We have not dreaded it, we have looked forward to it. After 3 years we cannot be unduly concerned by a few delays. The important consideration is that everything be ready that nothing be jeopardized by haste which can be preserved by prudent action.

The initial unusual experience of the mission is that of being on top of the Atlas launch vehicle after the gantry has been pulled back. Through the periscope much of Cape Canaveral can be seen. If you move back and forth in the couch you can feel the entire vehicle moving very slightly. When the engines are gimbaled you can feel the vibration. When the tank is filled with liquid oxygen the spacecraft vibrates and shudders as the metal skin flexes. Through the window and periscope the white plume of the lox (liquid oxygen) venting is visible.

Launch

When the countdown reached zero, I could feel the engines start. The spacecraft shook not violently but very solidly. There was no doubt when lift-off occurred. When the Atlas was released there was an immediate gentle surge that let you know you were on your way. The roll to the correct azimuth was noticeable after lift-off. I had preset the little window mirror to watch the ground. I glanced up after lift-off and could see the horizon turning. Some vibration occurred immediately after lift-off. It smoothed out after about 10 to 15 sec. of flight but never completely stopped. There was still a noticeable amount of vibration that continued up to the time the spacecraft passed through the maximum aerodynamic pressure or maximum q at approximately T + 1 minute.

The approach of maximum q is signaled by more intense vibrations. Force on the outside of the spacecraft was calculated at 932 pounds per square foot at this time. During this period I was conscious of a dull muffled roar from the engines. Beyond the high q area the vibration smoothed out noticeably. However, the spacecraft never became completely vibration free during powered flight.

The acceleration buildup was noticeable but not bothersome. Before the flight my backup pilot, Astronaut Scott Carpenter, had said he thought it would feel good to go in a straight line acceleration rather than just in circles as we had in the centrifuge and he was right. Booster engine cut-off occurred at 2 min. 9.6 sec. after lift-off. As the two outboard engines shut down and were detached, the acceleration dropped but not as sharply as I had anticipated. Instead, it decayed over approximately ½ sec. There is a change in noise level and vibration when these engines are jettisoned. I saw a flash of smoke out the window and thought at first that the escape tower had jettisoned early and so reported. However, this flash was apparently deflected smoke coming up around the spacecraft from the booster engines which had just separated. The tower was jettisoned at 2 min. 33.3 sec., and I corrected my earlier report. I was ready to back up the automatic sequencing system if it did not perform correctly and counted down the seconds to the time for tower jettisoning. I was looking at the nozzles of the tower rockets when they fired. A large cloud of smoke came out but little flame. The tower accelerated rapidly from the spacecraft in a straight line. I watched it to a distance of approximately ½ mi. The spacecraft was programmed to pitch down slowly just prior to jettisoning the tower and this maneuver provided my first real view of the horizon and clouds. I could just see clouds and the horizon behind the tower as it jettisoned.

After the tower fired, the spacecraft pitched slowly up again and I lost sight of the horizon. I remember making a comment at about this time that the sky was very black. The acceleration built up again, but as before, acceleration was not a major problem.

I could communicate well, up to the maximum of 7.7g at insertion when the sustainer-engine thrust terminates.

Just before the end of powered flight, there was one experience I was not expecting. At the time the fuel and lox tanks were getting empty and apparently the Atlas becomes considerably more flexible than when filled. I had the sensation of being out on the end of a springboard and could feel oscillating motions as if the nose of the launch vehicle were waving back and forth slightly.

Insertion into Orbit

The noise also increased as the vehicle approached SECO (sustainer engine cutoff). When the sustainer engine cutoff at 5 min. 1.4 sec. and the acceleration dropped to zero I had a slight sensation of tumbling forward. The astronauts have often had a similar sensation during training on the centrifuge. The sensation was much less during the flight, and since the spacecraft did pitch down at this point it may have been a result of actual movement rather than an illusion.

There was no doubt when the clamp ring between the Atlas and the Mercury spacecraft fired. There was a loud report and I immediately felt the force of the posigrade rockets which separate the spacecraft from the launch vehicle. Prior to the flight I had imagined that the acceleration from these three small rockets would be insignificant and that we might fail to sense them entirely, but there is no doubt when they fire.

Immediately after separation from the Atlas the autopilot started to turn the spacecraft around. As the spacecraft came around to its normal aft viewing attitude I could see the Atlas through the window. At the time I estimated that it was a couple of hundred yards away. After the flight an analysis of the trajectory data showed that the distance between the launch vehicle and the spacecraft should at this point be 600 ft. Close enough for a rough estimate. I do not claim that I can normally judge distance so close. There was a large sized luck factor in the estimate; nevertheless the facts do give an indication that man can make an adequate judgment at least of short distances to a known object in space. This capability will be important in future missions in which man will want to achieve rendezvous since the pilot will be counted on to perform the final closing maneuver.

I was able to keep the Atlas in sight for 6 or 7 min. while it traveled across the Atlantic. The last time I reported seeing it the Atlas was approximately 2 mi. behind and 1 mi. below the spacecraft. It could be seen easily as a bright object against the black background of space and later against the background of earth.

Orbit

The autopilot turned the spacecraft around and put it into the proper attitude. After my initial contact with Bermuda I secured the times for firing the retrorockets and rotated the check of the controls. This is a test of the control systems aboard the spacecraft. I had practiced it many times on the ground in the Mercury procedures trainer and the test went just as it had in the trainer. I was elated by the precision with which the test progressed. It is quite an intricate check. With your right hand you move the control stick, operating the hydrogen peroxide thrusters to move the spacecraft in roll, pitch and yaw. With your left hand you switch from one control system to another as the spacecraft is manually controlled to a number of precise rates and attitudes.

This experience was the first time I had been in complete manual control and it was very reassuring to see not only the spacecraft react as expected but also to see my own ability to control was as we had hoped.

Following this controls check I went back to autopilot control and the spacecraft operated properly on autopilot throughout the first orbit.

Thruster Problem

Because of a malfunction in a low torque thruster at the end of the first orbit it was necessary to control the spacecraft manually for the last two orbits. This requirement introduced no serious problems and actually provided me with an opportunity to demonstrate what a man can do in controlling a spacecraft. However, it limited the time that could be spent on many of the experiments I had hoped to carry out during the flight.

The Mercury flight plan during the first orbit was to maintain optimum spacecraft attitude for radar tracking and communication checks. This plan would provide good trajectory information as early as possible and would give me a chance to adapt to these new conditions if such was necessary. Other observations and tasks were to be accomplished mainly on the second and third orbits. Since the thruster problem made it necessary for me to control manually during most of the second and third orbits several of the planned observations and experiments were not accomplished.

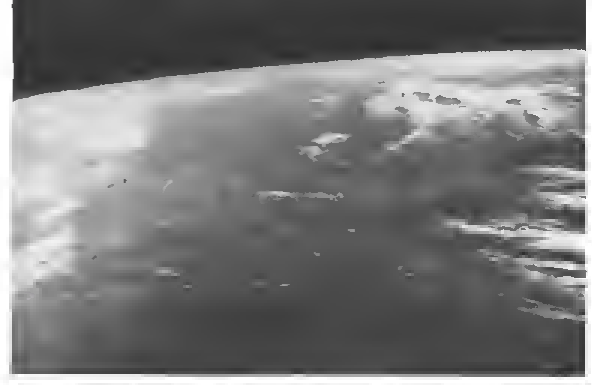
A number of questions have been raised over the ability of a man to use the earth's horizon as a reference for controlling the attitude of the space vehicle.

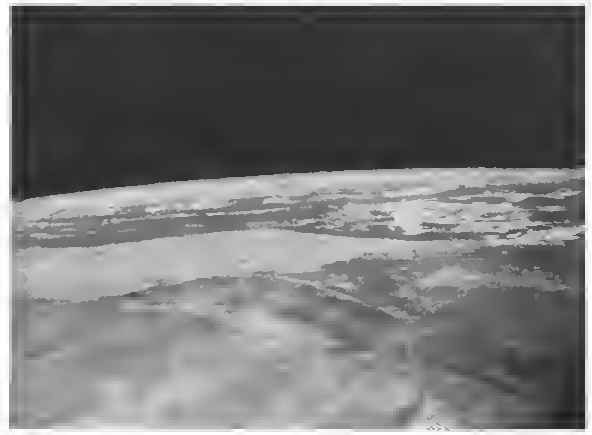
Throughout this flight no trouble in seeing the horizon was encountered. During the day the earth is bright and the background of space is dark. The horizon is vividly marked. At night before the moon is up, the horizon can still be seen against the background of stars. After the moon rises (during this flight the moon was full) the earth is well enough lighted so that the horizon can be clearly seen.

Learning Period

With this horizon as a reference, the pitch and roll attitudes of the spacecraft can easily be controlled. The window can be positioned where you want it. Yaw, or heading reference however, is not so good. I believe that there was a learning period during the flight regarding my ability to determine yaw. Use of the view through the window and periscope gradually improved.

To determine yaw in the spacecraft ad





FLORIDA COAST was photographed by Astronaut Glenn as he began his second orbit in the Friendship 7 Mercury capsule (top). Picture was taken through capsule window while capsule was orbiting at 17,500 mph. at about 100 mi. altitude. Glenn used a modified Ansco Autoset 35 mm. camera. Bottom photo taken by Glenn shows North Africa. The Atlas mountain range near the African west coast is in this photo.

vantage must be taken of the speed of the spacecraft over the earth which produces an apparent drift of the ground below the spacecraft. When the spacecraft is properly oriented facing along the plane of the orbit the ground appears to move parallel to the spacecraft longitudinal axis.

During the flight I developed a procedure which seemed to help me use this terrain drift as a yaw reference. I would pitch the small end of the spacecraft down to about —60 deg. from the normal attitude where a fairly good vertical view was available. In this attitude, clouds and land moving out from under me had more apparent motion than when the spacecraft was in its normal orbit attitude and I looked off toward the horizon.

At night with the full moon illuminating the clouds below, I could still determine yaw through the window but not as rapidly as in the daytime. At night I could use the drift of stars to determine heading but this took longer and was less accurate.

Throughout the flight I preferred the window to the periscope as an attitude reference system. It seemed to take longer to adjust yaw by using the periscope on the day side. At night the cloud illumination by the moon is too dim to be seen well through the periscope.

Three times during the flight I turned the spacecraft approximately 180° in yaw and faced forward in the direction of flight. I liked this attitude—seeing where I was going rather than where I had been—much better. As a result of these maneuvers my instrument reference system gave me an inaccurate attitude indication. It was easy to determine the proper attitude, however, from reference to the horizon through the window or to the periscope. Maintaining orientation was no problem, but I believe that the pilot automatically relies much more completely on vision in space than he does in an airplane, where gravity cues are available. The success with which I was able to control the spacecraft at all times was to me one of the most significant features of the flight.

Weightlessness

Weightlessness was a pleasant experience. I reported I felt fine as soon as the spacecraft separated from the launch vehicle and throughout the flight this feeling continued to be the same.

Approximately every 30 min. throughout the flight I went through a series of exercises to determine whether weightlessness was affecting me in any way. To see if head movement in a zero g environment produced any symptoms of nausea or vertigo, I tried first moving, then shaking my head from side to side, up and down, and tilting it from shoulder to shoulder. In other words, moving my head in roll, pitch and yaw. I began slowly, but as the flight progressed, I moved my head more rapidly and vigorously until at the end of the flight I was moving as rapidly as my pressure suit would allow.

In another test, using only eye motions, I tracked a rapidly moving spot of light generated by my finger tip lights. I had no problem watching the spot and once again no sensations of dizziness or nausea. A small eye chart was included on the instrument panel, with letters of varying size and with a "spoked wheel" pattern to check both general vision and any tendency toward astigmatism. No change from normal was apparent.

An oculogyre test was made in which turning rates of the spacecraft were correlated with sensations and eye movements. Results were normal. Preflight experience on this test and a calibration had been made at the Naval School of Aviation Medicine, Pensacola, Fla., with Dr. Ashton Graybiel, so that I was thoroughly familiar with my reactions to these same movements at 1g.

To provide medical data on the cardiovascular system at intervals, I did an exercise which consisted of pulling on a bungee cord once a second for 30 sec. This exercise provided a known workload to compare with previous similar tests made on the ground. The flight surgeons have reported the effect that this had on my pulse and blood pressure. The effect that it had on me during the flight was the same effect that it had on the ground—it made me tired.

Another experiment related to the possible medical effects of weightlessness was eating in orbit. On the relatively short flight of Friendship 7, eating was not a necessity, but rather an attempt to determine whether there would be any problem in consuming and digesting food in a weightless state. At no time did I have any difficulty eating. I believe that any type of food can be eaten as long as it does not come apart easily or make crumbs. Prior

Telstar Checked for Booster Compatibility

American Telephone & Telegraph's Telstar communications satellite configuration is checked at Douglas Aircraft's Missile & Space Systems Division, Santa Monica, Calif., for compatibility with third stage of Delta launch vehicle and shrouds which envelop satellite test model. Douglas is prime contractor to NASA for Delta.

to the flight, we joked about taking along some normal food such as a ham sandwich. I think this would be practical and should be tried.

Sitting in the spacecraft under zero g is more pleasant than under 1g on the ground, since you are not subject to any pressure points. I felt that I adapted very rapidly to weightlessness. I had no tendency to overreach nor did I experience any other sign of lack of coordination, even on the first movements after separation. I found myself unconsciously taking advantage of the weightless condition, as when I would leave a camera or some other object floating in space while I attended to other matters. This was not done as a preplanned maneuver but as a spur-of-the-moment thing when another system needed my attention. I thought later about how I had done this as naturally as if I were laying the camera on a table in a 1g field. It pointedly illustrates how rapidly adaptable the human is, even to something as foreign as weightlessness.

We discovered from this flight that some problems are still to be solved in properly determining how to stow and secure equipment that is used in a space vehicle. I had brought along a number of instruments such as cameras, binoculars, and a photometer, with which to make observations from the spacecraft. All of these were stowed in a duffy bag by my right arm. Each piece of equipment had a 3-ft piece of line attached to it. By the time I had started using items of the equipment, these lines became tangled. Although these lines got in the way, it was still important to have some way of securing the equipment, as I found out when I attempted to change film. The small canisters of film were not tied to the duffy bag by lines. I left one floating in midair while working with the camera, and when I reached for it, I accidentally hit it and it floated out of sight behind the instrument panel.

Color and Light

As I looked back at the earth from space, colors and light intensities were much the same as I had observed when flying at high altitude in an airplane. The colors observed when looking down at the ground appeared similar to those seen from 50,000 ft. When looking toward the horizon, however, the view is completely different, for then the blackness of space contrasts vividly with the brightness of the earth. The horizon itself is a brilliant, brilliant blue and white.

It was surprising how much of the earth's surface was covered by clouds. The clouds can be seen very clearly on the daylight side. The different types of clouds—vertical developments, stratus clouds and cumulus clouds—are readily distinguished. There is little problem identifying them or in seeing the weather patterns. You can estimate the relative heights of the cloud layers from your knowledge of the types or from the shadows the high clouds cast on those lower down.

These observations are representative of information which the scientists of the U.S. Weather Bureau, Meteorological Satellite Laboratory had asked Project Mercury to determine. They are interested in improving the optical equipment in their Tiros and Nimbus satellites and would like to know if they could determine the altitude of cloud layers with better optical resolution. From my flight I would say it is quite possible to determine cloud heights from this orbital altitude.

Only a few land areas were visible during the flight because of the cloud cover. Clouds were over much of the Atlantic, but the western (Sahara) part of Africa was clear. In this desert region I could plainly see dust storms. By the time I got to the east coast of Africa where I might have been able to see towns, the land was covered by clouds. The Indian Ocean was the same.

Western Australia was clear, but the eastern half was overcast. Most of the area across Mexico and nearly to New Orleans was covered with high cirrus clouds. As I came across the United States I could see New Orleans, Charleston and Savannah very clearly. I could also see rivers and lakes. I think the best view I had of any land area during the flight was the clear desert region around El Paso on the second pass across the United States. I could see the colors of the desert and the irrigated area north of El Paso. As I passed off the east coast of the United States I could see across Florida and far back along the Gulf Coast.

Over the Atlantic I saw what I assume was the Gulf Stream. The different colors of the water are clearly visible.

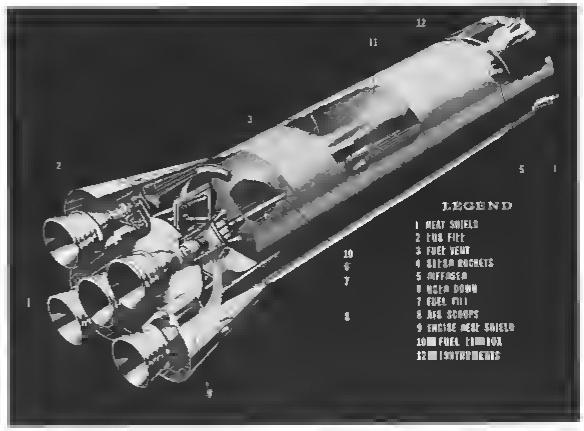
I also observed what was probably the wake of a ship. As I was passing over the recovery area at the end of the second orbit I looked down at the water and saw a little "V". I checked the map. I was over recovery area C at the time, so I think it was probably the wake from a recovery ship. When I looked again the little "V" was under a cloud. The change in light reflections caused by the wake of a ship are sometimes visible for long distances from an airplane and will linger for miles behind a ship. This wake was probably what was visible.

I believe however that most people have an erroneous conception that from orbital altitude, little detail can be seen. In clear desert air, it is common to see a mountain range 100 or so miles away very clearly and all that vision is through atmosphere. From orbital altitude atmospheric light attenuation is only through approximately 100,000 ft of atmosphere, so it is even more clear. An interesting experiment for future flights can be to determine visibility of objects of different sizes, colors and shapes.

Obviously, on the night side of the earth much less was visible. This may have been due not only to the reduced light, but also partly to the fact that I was never fully dark adapted. In the bright light of the full moon, the clouds are visible. I could see vertical development at night. Most of the cloudy areas however appeared to be stratoform.

The lights of the city of Perth, in Western Australia, were on and I could see them well. The view was similar to that seen when flying at high altitude at night over a small town. South of Perth there was a small group of lights but they were much brighter in intensity. Inland there was a series of four or five towns lying in a line running from east to west. Knowing that Perth was on the coast I was just barely able to see the coastline of Australia. Clouds covered the area of eastern Australia around Woomera, and I saw nothing but clouds from there across the Pacific until I was east of Hawaii. There appeared to be a almost solid cloud cover all the way.

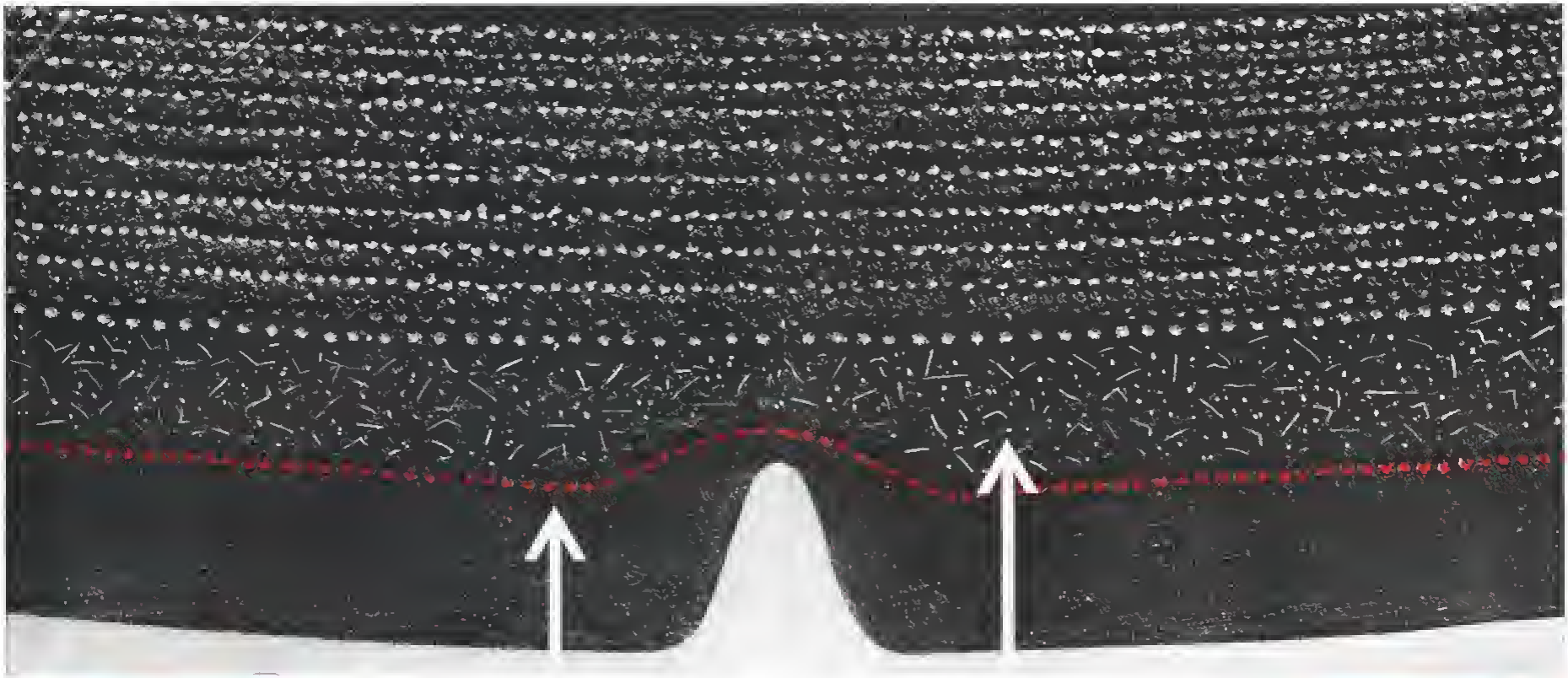
Just off the east coast of Africa there



Saturn C-5's S-1C Booster Detailed

Cutaway drawing of the S-1C booster for the Saturn C-5 launch vehicle shows arrangement of the major subsystems. The booster will be built by Boeing Co. at National Aeronautics and Space Administration's Michoud, La., manufacturing facility. It will be 33 ft in diameter, about 75 ft high and contain a cluster of five Rocketdyne F-1 engines. Fins between flared skirts are not shown.

Goodyear announces the world's most reliable airplane tire



EXCLUSIVE FEATURE #1: Built-in "Red Line" tells tire replacement time

Makes tire inspection easier and more accurate than ever before. The "Red Line"—a ply of red fabric cord—appears when 80% of the tread is gone. Tells you when tire replacement time is near—with a good safety margin. And, unlike other tread wear indicators, it adds strength to the tire.

If you want to know more about this new Goodyear "Red Line" tire—or about our new developments in wheels, brakes, and anti-skid systems, thermoelectric systems, thermal-shielding materials or rubberized fabrics—write Goodyear Aviation Products Dept. P-1715, Akron 16, Ohio.

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Prevents most carcass cuts. Helps stop small cuts from growing. Preserves the tire for retreading. Made of shredded wire placed between the body fabric and tread rubber, this Goodyear-developed shield can make the difference between a tire ready for the scrap heap and one ready for retreading—with big savings for you.

GOODYEAR
AVIATION PRODUCTS

two large storm areas. Weather Bureau scientists had wondered whether lightning could be seen on the night side, and it certainly can. A large storm was visible just north of my track over the Indian Ocean and a smaller one to the south. Lightning could be seen flashing back and forth between the clouds but most prominent were lightning flashes within thunderheads illuminating them like light bulbs.

Some of the most spectacular sights during the flight were sunsets. The sunsets always occurred slightly to my left and I turned the spacecraft to get a better view. The sunlight coming in the window was very brilliant, with an intense clear white light that reminded me of the arc lights while the spacecraft was on the launching pad.

I watched the first sunset through the photometer which had a polarizing filter on the front so that the intensity of the sun could be reduced to a comfortable level for viewing. Later I found that by squinting, I could look directly at the sun with no ill effects, just as I can from the surface of the earth. This accomplished little of value but does give an idea of intensity.

The sun is perfectly round as it approaches the horizon. It retains most of its symmetry until just the last sliver is visible. The horizon on each side of the sun is extremely bright and when the sun has gone down to the level of this bright band of the horizon it seems to spread out to each side of the point where it is setting. With the camera I caught the flattening of the sun just before it set. This is a phenomenon of some interest to the astronomers.

As the sun moves toward the horizon a black shadow of darkness moves across the earth until the whole surface except for the bright band at the horizon is dark. This band is extremely bright just as the sun sets but as time passes the bottom layer becomes a bright orange and fades into reds then on into the darker colors and finally off into the blues and blacks. One thing that surprised me was the distance the light extends on the horizon on each side of the point of the sunset. I think that the eye can see a little more of the sunset color band than the camera captures. One point of interest was the length of time during which the orbital twilight persisted. Light was visible along the horizon for 4 to 5 min. after the sunset, a long time when you consider that sunset occurred 18 times faster than normal.

The period immediately following sunset was of special interest to the astronomers. Because of atmospheric light scattering it is not possible to study the region close to the sun except at the time of a solar eclipse. It had been hoped that from above the atmosphere the area close to the sun could be observed.

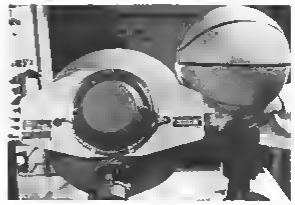
However this would require a period of dark adaptation prior to sunset. An eye patch had been developed for this purpose which was to be held in place by special tape. This patch was expected to permit one eye to be night adapted prior to sunset. Unfortunately the tape proved unsatisfactory and I could not use the eye patch. Observations of the sun's corona and zodiacal light must await future flights when the pilot may have an opportunity to get more fully dark adapted prior to sunset.

Another experiment suggested by our advisors in astronomy was to obtain ultraviolet spectrographs of the stars in the belt and sword of Orion. The ozone layer of the earth's atmosphere will not pass ultraviolet light below 3,000 angstroms. The spacecraft window will pass light down to 2,000 angstroms. It is possible therefore to get pictures of the stars from the Mercury spacecraft which cannot be duplicated by the largest telescope on the ground. Several ultraviolet spectrographs were taken of the stars in the belt of Orion. They are being studied at the present time to see whether useful information was obtained.

The biggest surprise of the flight occurred at dawn. Coming out of the night on the first orbit at the first glint of sunlight on the spacecraft I was looking inside the spacecraft checking instruments for perhaps 15 to 20 sec. When I glanced back through the window my initial reaction was that the spacecraft had tumbled and that I could see nothing but stars through the window. I realized however that I was still in the normal attitude. The spacecraft was surrounded by luminous particles.

These particles were a light yellowish green color. It was as if the spacecraft were moving through a field of fireflies. They were about the brightness of a first magnitude star and appeared to vary in size from a pinhead up to possibly ½ in. They were about 8 to 10 ft. apart and evenly distributed through the space around the spacecraft. Occasionally one or two of them would move slowly up around the spacecraft and across the window drifting very, very slowly and would then gradually move off back in the direction I was looking. I observed these luminous objects for approximately 4 min. each time the sun came up.

During the third sunrise I turned the spacecraft around and faced forward to see if I could determine where the particles were coming from. Facing forwards I could see only about 10% as many particles as I had when my back was to the sun. Still they seemed to be coming towards me from some distance so that they appeared not to be coming from the spacecraft. Just what these particles are is still subject to debate and awaits further clarification. Dr. John O'Keefe at the NASA Goddard Space Flight Center is making a study in an attempt to determine what these particles might be.



Polaris Mk. 2 Guidance

Polaris Mark 2 inertial guidance system for new 2,500 mi. A-3 missile is less than half the size and weight of the Mark 1 used on A-1 and A-2 missiles, but has greater accuracy and is expected to have improved reliability. The basketball-sized Mark 2, developed by Massachusetts Institute of Technology, will be built by General Electric, with Raytheon supplying digital computer and controls. New system uses three floated integrated gyros, one pendulous gyro accelerometer and two new pulsed integrating pendulum accelerometers.

Other Planned Observations

As mentioned earlier, a number of other observations and measurements during orbit had to be canceled because of the control system problems. Equipment carried was not highly sophisticated scientific equipment. We believed however that it would show the feasibility of making more comprehensive measurements on later missions.

Some of these areas of investigation that we planned but did not have an opportunity to check are as follows:

- **Weather Bureau observations**
  - (1) Pictures of weather areas and cloud formations to match against map forecasts and Tiros pictures.
  - (2) Filter mosaic pictures of major weather centers.
  - (3) Observation of green air glow from air and weather centers in 5,577 angstrom band with air glow filter.
  - (4) Albedo intensities—measure reflected light intensities on both day and night side.
- **Astronomical observations**
  - (1) Light polarization from area of sun.
  - (2) Comets close to sun.
  - (3) Zodiacal light.
  - (4) Sunlight intensity.
  - (5) Lunar clouds.
  - (6) Gegenschein.
  - (7) Starlight intensity measurements.
- **Test for otolith balance disturbance and autokynesis phenomena.**
- **Vision tests.**
  - (1) Night vision adaptation.
  - (2) Photometer eye measurements.
- **Drinking.**

After having turned around on the last orbit to see the particles, I maneuvered into the correct attitude for firing the retrorockets and stowed the equipment in the ditty bag.

This last dawn found my attitude indicators still slightly in error. However before it was time to fire the retrorockets the horizon scanner slaving mechanism had brought the gyros back to orbit attitude. I crosschecked repeatedly between the instruments, periscope presentation and the attitude through the window.

Although there were variations in the instrument presentations during the flight, there was never any difficulty in determining my true attitude by reference to the window or periscope. I received a countdown from the ground and the retrorockets were fired on schedule just off the California coast.

I could hear each rocket fire and could feel the surge as the rockets slowed the spacecraft. Coming out of zero g condition the retrorocket firing produced the sensation that I was accelerating back to-

ward Hawaii. This sensation, of course, was an illusion.

Following retrofire the decision was made to have me re-enter with the retro package still on because of the uncertainty as to whether the landing bag had been extended. This decision required me to perform manually a number of the operations which are normally automatically programmed during the re-entry. These maneuvers I accomplished. I brought the spacecraft to the proper attitude for re-entry under manual control. The periscope was retracted by pumping the manual retraction lever.

As deceleration began to increase I could hear a hissing noise that sounded like small particles brushing against the spacecraft.

Due to ionization around the spacecraft, communications were lost. This had occurred on earlier missions and was experienced now on the predicted schedule. As the heat pulse started there was a noise and a bump on the spacecraft. I saw one of the straps that holds the retrorocket package swing in front of the window.

The heat pulse increased until I could see a glowing orange color through the window. Flaming pieces were breaking off and flying past the spacecraft window. At the time these observations were of some concern to me because I was not sure what they were. I had assumed that the retropack had been jettisoned when I saw the strap in front of the window. I thought these flaming pieces might be parts of the heat shield breaking off. We know now, of course, that the pieces were from the retropack.

There was no doubt when the heat pulse occurred during re-entry, but it takes time for the heat to soak into the spacecraft and heat the air. I did not feel particularly hot until we were getting down to about 75,000 to 80,000 ft. From there on down I was uncomfortably warm, and by the time the main parachute was out I was perspiring profusely.

The re-entry deceleration of 7.7g was as expected and was similar to that experienced in centrifuge runs. There had been some question as to whether our ability to tolerate acceleration might be worse because of the 4½ hr. of weightlessness, but I could note no difference between my feeling of deceleration on this flight and my training sessions in the centrifuge.

After peak deceleration the amplitude of the spacecraft oscillations began to build. I kept them under control on the manual and fly-by-wire systems until I ran out of manual fuel. After that point I was unknowingly left with only the fly-by-wire system and the oscillations increased, so I switched to auxiliary damping which controlled the spacecraft until the automatic fuel was also expended. I was reaching for the switch to deploy the drogue parachute early in order to reduce these re-entry oscillations when it was deployed automatically. The drogue parachute stabilized the spacecraft rapidly.

At 10,800 ft. the main parachute was deployed. I could see it stream out behind me, fill partially and then as the reefing line cutters were actuated it filled completely. The opening of the parachute caused a jolt, but perhaps less than I had expected.

The landing deceleration was sharper than I had expected. Prior to impact I had disconnected all the extra leads to my suit, and was ready for rapid egress, but there was no need for this. I had a message that the destroyer *Nea* would pick me up within 20 min. I lay quietly in the spacecraft trying to keep as cool as possible. The temperature inside the spacecraft did not seem to diminish. This, combined with the high humidity of the air being drawn into the spacecraft, kept me uncomfortably warm and perspiring heavily. Once the *Nea* was alongside the spacecraft, there was little delay in starting the hoisting operation. The spacecraft was pulled part way out of the water to let the water drain from the landing bag.

During the spacecraft pickup, I received one good bump. It was probably the most solid jolt of the whole trip as the spacecraft swung against the side of the ship. Shortly afterwards the spacecraft was on the deck.

I had initially planned egress out through the top, but by this time I had been perspiring heavily for nearly 45 min. I decided to come out the side hatch instead.

General Remarks

Many things were learned from the flight of Friendship 7. Concerning spacecraft systems alone, you have heard many reports today that have verified previous design concepts or have shown weak spots that need remedial action.

Now, what can be said of man in the system?

Of major significance is the probability that much more dependence can be placed on the man as a reliably operating portion of the man-spacecraft combination. In many areas his safe return can be made dependent on his own intelligent actions. Although a design philosophy could not be followed up to this time, Project Mercury never considered the astronaut as merely a passive passenger.

These areas must be assessed carefully,

for man is not infallible, as we are all acutely aware. As an in-flight example, some of you may have noticed a slight discrepancy between launch photographs of the pilot and similar re-entry views. The face plate on the helmet was open during the re-entry phase. Had cabin pressure started to drop, I could have closed the face plate in sufficient time to prevent decompression, but nevertheless a face plate open re-entry was not planned.

On the ground, some things would also be done differently. As an example, I feel it more advisable in the event of suspected malfunctions, such as the heat shield–retropack difficulties that require extensive discussion among ground personnel to keep the pilot updated on each bit of information rather than waiting for a final clear-cut recommendation from the ground. This keeps the pilot fully informed if there would happen to be any communication difficulty and it became necessary for him to make all decisions from onboard information.

Many things would be done differently if this flight could be flown over again, but we learn from our mistakes. I never flew a test flight on an airplane that I didn't return wishing I had done some things differently.

Even where automatic systems are still necessary, mission reliability is tremendously increased by having the man as a backup. The flight of Friendship 7 is a good example. This mission would almost certainly not have completed its three orbits, and might not have come back at all, if a man had not been aboard.

The flight of the Friendship 7 Mercury spacecraft has proved that man can adapt very rapidly to this new environment. His senses and capabilities are little changed in space. At least for the 4.5 hr. duration of this mission, weightlessness was no problem.

Man's adaptability is most evident in his powers of observation. He can accomplish many more and varied experiments per mission than can be obtained from an unmanned vehicle. When the unexpected arises, as happened with the luminous particles and layer observations on this flight, he can make observations that will permit more rapid evaluation of these phenomena on future flights. Indeed, on an unmanned flight there likely would have been no such observations.

Most important, however, the future will not always find us as power limited as we are now. We will progress to the point where missions will not be totally preplanned. There will be choices of action in space and man's intelligence and decision making capability will be mandatory.

Our recent space efforts can be likened to the first flights at Kitty Hawk. They were first unmanned but were followed by manned flights completely preplanned and of a few seconds duration. Their experiments were again power limited, but they soon progressed beyond that point.

Space exploration is now at the same stage of development.

From all of the papers in this volume I am sure you will agree with me that some big steps have been taken toward accomplishing the mission objectives expressed at the beginning of this paper.

Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

General Electric CT58-powered Sikarsky S-61L flies over Los Angeles The new twin-turbine helicopter started passengar service with Los Angeles Airways March 1,

Los Angeles Airways Inaugurates CT58-Powered 'Copter Service

LOS ANGELES, Calif —New twin-turbine helicopters were placed in passenger service in this area on March 1 by Los Angeles Airways. Powered by General Electric CT58-110 engines, the new Sikorsky S-61L turbocopters now link Los Angeles International Airport and Anaheim, Pomona and San Bernardino

General Electric's CT58 engine was the first FAA certificated US helicopter gas turbine In Los Angeles Airways service the engine has been approved for 1000 hours between overhauls with sampling of the first two engines at the 800 hour mark.

The 28 passenger S-61L turbocopter reduces non-stop flight time between Los Angeles and San Bernardino by 16 minutes taking only 32 minutes for the trip Travel time is reduced from 20 to 16 minutes between Los Angeles and Anaheim, and from 25 to 20 minutes between Los Angeles and Pomona in the 136 mph S-61L.

In commemorating the inaugurel of the new service Clarence M Behnn, President of Los Angeles Airways, said "This date will mark new dimensions of air travel by the smoothest, fastest and most modern helicopters yet to be placed in service anywhere in the world"

In addition to Los Angeles Airways, major helicopter airlines in New York, Chicago and San Francisco-Oakland heve selected the CT58 to power their new turbocopters A military version of the CT58-110, designated the T58-8, powers helicopters selected for service with the US Navy, Marine Corps, Air Force and Coast Guard

DAL Convair 880 Jets Shatter Nine Speed Marks

CINCINNATI, Ohio—Three new commercial speed marks by Delta Air Lines' General Electric-powered Convair 880 fleet boost its number of intercity records to nine

Delta's newest record came March 8 on a Los Angeles to New Orleans hop. The 880 covered the 1725 miles in two hours, 41 minutes, 50 seconds at a speed of 659 mph Other records also set this year Chicago (O'Hare)-Miami, 1259 miles, 680 mph, 1 50 55, and Chicago-Houston, 946 miles, 650 mph, 1 31 27

Commercial transcontinental speed marks fell fast after the Federal Aviation Agency awarded the first 880 Flight Certificate on May 1, 1960 Delta's initial record came during delivery of its first 880 The aircraft raced the 2359 miles from San Diego to Miami in three hours, 31 minutes to set a southern transcontinental speed mark. Average speed was 664 mph.

Additional records came on flights from San Diego-Atlanta, 1935 miles, 580 mph, 3 24 59, New Orleans-Baltimore, 993 miles, 605 mph, 1 38 45; San Francisco-New Orleans, 1914 miles, 586 mph, 3 18 56, Atlanta-San Francisco, 2195 miles, 530 mph, 4 18 41, and Houston-Chicago, 946 miles, 650, mph, 1 29 10

Northrop and McDonnell Aircraft Set Nine New Time-to-Climb Records

CINCINNATI, Ohio—Two G E-powered military jet aircraft blitzed the world record books recently by successively slashing international time-to-climb records to new low marks.

First to launch attack on the standing time-to-climb records, held since 1958 by the Air Force's Lockheed F-104 Starfighter, was the USAF Northrop T-38 supersonic trainer The lightweight twin-J85-powered Talon streaked to 39,000 feet to reduce standing records for 3000, 6000, 9000 and 12,000 meters by considerable margins.

A few weeks later the U S Navy's J79-powered McDonnell F4H Phantom II fighter scorched through the same exercise, edging out the T-38's records with new low marks of its own and going on to rewrite the Starfighter's formerly held 15,000 meter mark

Time-to-climb records for 20,000, 25,000 and 30,000 meters are still held by the J79-powered F-104.

New F4H records in the time-to-climb category (timed from brake release to altitude under NAA supervision) are as follows: 3000 meters, 34 52 seconds; 6000 meters, 48.79; 9000 meters, 61 63, 12,000 meters, 77.16, and 15,000 meters, 114 55

Previous T-38 records were 35 62, 51.43; 64.76; and 95 74 seconds respectively

The F4H Phantom II, now operational with both Atlantic and Pacific fleet squadrons, is destined to become the Navy's standard Mach 2 carrier based all-weather fighter. The aircraft also claims several other world records, including the absolute speed mark of 1606 mph and the international sustained altitude record of 66,443 feet Its two afterburning J79 engines have a combined thrust of up to 34,000 lbs

Northrop's T-38 Talon, powered by twin G-E J85's, is now in service as the USAF's first supersonic aircraft designed expressly for pilot training The aircraft can maintain supersonic speed in level flight at any altitude from sea level to 50,000 feet.

McDonnell F4H lands after streaking to one of five new time-to-climb marks

MIDWAY—Record-smashing B-58 Hustler refuels over the Atlantic Ocean before returning to Los Angeles for a round trip record of four hours and forty two minutes

B-58 Hustler Smashes Speed Marks

LOS ANGELES, Calif —America's newest cross-country speed record is a remarkable four-hour, 42-minute round trip from Los Angeles to New York City and back flown last month by a USAF B-58 jet bomber.

Powered by four General Electric J79 turbojet engines, the delta-wing General Dynamics bomber set two additional records in its transcontinental jaunt west-to-east, two hours, one minute, 39 seconds, and east-to-west, two hours, 15 minutes, 12 seconds

The B-58 Hustler bettered by more than two hours the old round-trip mark set in 1957 by a McDonnell RF-101 Voodoo Honors for the record-smashing performance include the 1962 Bendix trophy for the aircraft, and Distinguished Flying Crosses for each of its crewmen

According to flight plan, the B 58 took off from Carswell AFB Texas, flew to Los Angeles and refueled over the Pacific before starting east at 8 34 a m Three aerial refuelings were required before the jet bomber touched down at L.A International Airport at 1 16 p m.

America's only Mach 2 bomber, the B-58 is powered by four G-E J79 turbojets that produce a total of up to 62,400 pounds of thrust

General Electric J79's have flown more than one-quarter million hours, and have more Mach 2 flight time than all other free world turbojets combined. The J79-5B's which power the B-58 now operate with a 1000-hour time between overhaul and a 600-hour periodic inspection—the only Mach 2 engine with such an advanced TBO rating

Today's General Electric J79 turbojet has the distinction of having powered military aircraft to 32 international jet flight records In addition to the B-58, J79s power the North American A3J Vigilante, McDonnell F4H Phantom II, and Lockheed F-104 Starfighter

CJ-805's Advanced To 1800-hour TBO; TWA Expects 2000

CINCINNATI, Ohio—Delta Air Lines and Trans World Airlines recently received 1800-hour Time Between Overhaul approval for the General Electric CJ-805-3 engines on their Convair 880 s, and TWA expects a hike to 2000 hours before May.

The new extension to 1800 hours, granted by the Federal Aviation Agency, continues the CJ 805-3 turbojet's record of having attained the fastest advancement in TBO allowed under present FAA regulations

TWA's anticipated 2000-hour TBO comes seven months earlier than General Electric's original projection for reaching that mark Delta and Northeast Airlines are expected to reach 2000 hours sometime after mid-year.

Airline users report that in nearly two years of service no General Electric CJ-805 engine has ever been *prematurely* overhauled as a result of damage or other cause In each case the cause of premature removals was reparable without overhaul.

When the 880 started commercial service in mid 1960, initial FAA regulations required overhaul of a small sample of engines at 600 hours in order to substantiate a basic TBO period of 1000 hours

Since reaching the 1000-hour mark, General Electric CJ-805 TBO has been advanced at the maximum allowable 200 hour increments in accordance with the FAA's current Turbine Engine Time Control Program

In addition to Delta, TWA and Northeast, Convair 880 and 880M jetliners are also in passenger service with Alaska Air Lines, Japan Air Lines, Civil Air Transport, VIASA, and Cathay Pacific Airways.

Control System for Advanced OAO Tested

By Barry Miller

Los Angeles—Data transmission and control system which ultimately is intended to command and control a minimum 50-in. aperture telescope aboard a two-ton high-altitude asynchronous, orbiting astronomical observatory began a test series recently at Tucson, Ariz., as the initial step in a long-range program aimed at putting the observatory in orbit later in this decade.

The system will employ a general purpose digital computer at a ground station to command the telescope and accept data from it, thereby closing the loop between satellite-borne and ground-based control elements.

The computer control system was developed by Astrodata, Inc., in nearby Anaheim, for the Kitt Peak National Observatory located in southern Arizona. Kitt Peak is operated by the Assn. of Universities for Research in Astronomy, Inc. (AURA), a non-profit group which is under contract from the National Science Foundation to develop an orbiting astronomical observatory (AW Jan. 15, p. 30) that may be launched as early as 1968.

While this program has no formal connection with National Aeronautics and Space Administration's Orbiting Astronomical Observatory (OAO), for which Grumman Aircraft Engineering Corp. is designing and building five observatories (AW Oct. 17, 1960, p. 30; Feb. 13, 1961, p. 54), it is regarded a potential OAO follow-on. Information on the respective programs is being exchanged by Grumman and Kitt Peak Observatory.

Present Aim

The OAO spacecraft constitutes an immediate, practical attempt to capitalize on contemporary booster technology to put a minimum amount of astronomical equipment in a low-altitude, circular (500 mi.) orbit that clears the earth's atmosphere. This will give astronomers a chance to observe characteristic stellar light through orbiting instruments before it is absorbed or distorted by the atmosphere. First OAO launching, using the Atlas-Agena B as a boost vehicle, is scheduled for late next year.

The Kitt Peak/NSF orbiting telescope is now being contemplated for a high-altitude, asynchronous orbit, roughly 23,400 naut. mi. or more, after an earlier idea for a stationary orbit (synchronous, equatorial orbit at 19,310 naut. mi.) was passed over because of the anticipated difficulty in achieving it. The high-altitude observatory may have several advantages over the lower-altitude OAO. It will provide longer line-of-sight time for ground command of the observatory, lessening the need for data storage in the spacecraft.

Targets being observed in space will not be blocked from view by the earth for lengthy periods as they would were the observatory at lower altitudes. In addition, the higher-altitude observatory will be less susceptible to effects of gravitational torques created by the divergence of the gravitational field as well as an accumulation of angular momentum caused by aerodynamic unbalance.

To place a spacecraft of the anticipated size of this observatory into a high-altitude orbit requires a booster with a thrust capability not now available. The observatory's weight and intended orbit would require a Saturn or one of the larger projected military vehicles, such as a Martin Titan 3 with a Lockheed Agena C upper stage. AURA originally planned to use the now discarded Saturn C-2. C-1 is regarded as marginal for the experiments.

The advanced observatory will have a higher weight carrying capability available to it than would OAO; it will carry a larger aperture telescope (minimum of 50 in., perhaps as large as 72-in.) compared with four smaller telescopes planned under Project Celescope (AW Feb. 19, p. 75) for OAO. This should give it an unusually high resolution. It is programed for a mean life time of five years, an extremely high goal at current levels of technology.

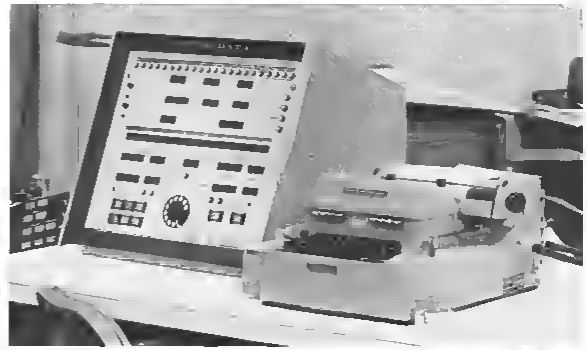
OAO control system is to be capable of pointing a 36- or 40-in. aperture telescope to an accuracy of a fraction of a sec. of arc for 45 min. to an hour. Specified accuracy of the advanced observatory lies between 0.1 and 0.01 sec. of arc, an accuracy which is to be held for many hours.

While details of the observatory are not yet firm, the system may conduct experiments involving interstellar dust, galactic structures and variable stars. Several types of instruments are under consideration for inclusion on the observatory. They include infrared and ultraviolet spectrometers, multi-color photometers, an absolute holometer and some form of image tube with which photographs may be obtained.

The control system delivered to Tucson recently by Astrodata is a closed loop servo data transmission system, with the loop closed by a general purpose Packard Bell 250 computer on the ground. Positions of telescopes in the satellite can be sensed, and then physically moved by satellite motors under command from the computer, which can be programed to supply commands to alter direction in which the telescope is looking.

A two-way path for transmitting and receiving data from additional experimental equipment which may be carried on the observatory is provided. In essence, the system is viewed only as a preliminary experiment to perfect a control system required to command the observatory. No actual flight hardware will be built for years, according to an official at Kitt Peak Observatory.

Tests of the data transmission/con-



CONTROL CONSOLE of data transmission and control system for advanced orbiting astronomical observatory will continuously display orientation of high-resolution telescope. Operator can dial desired changes in telescope position into console, have them displayed as they are entered into register. Flexowriter on table with console provides means of communicating with on-line computer which supplies preprogramed directions to telescope. System was built by Astrodata, Inc., Anaheim, Calif., for long-range orbiting telescope program being conducted by Assn. of Universities for Research in Astronomy, Inc.

trol system will proceed in three phases.

- **Phase 1**—The computer control system in Tucson, will be connected via coaxial cable to a telescope on Kitt Peak, roughly 40 miles away. A telescope mount, made by Boller & Chivens, South Pasadena, Calif. and scheduled for delivery to the peak this summer, will permit automated operation with the earth-based telescope, controlled from Tucson, simulating operation of the telescope in space.
- **Phase 2**—Cable between the computer system and the observatory will be broken and replaced by a microwave data transmission link, to test telescope operation remotely by radio link.
- **Phase 3**—Actual flight in which the satellite would be controlled by radio from the earth. For this phase both telescope and control system would be packaged for space use.

In effect, the complete data transmission and control system comprises the equivalent of a transmitter and receiver located with the telescope, another transmitter and receiver at the control center with a digital computer closing the loop. Magnetic and perforated tapes provide for storage and readout. Transmission bit rate currently is 1,000 bits/sec. At the transmitting end, a cable driver is fed from a biphase modulator. The receiver is another biphase modulator.

A technique is employed which enables digital signals which may be shrouded by noise to be recognized. Since noise statistically is expected to have zero average value, and the signal is known not to have a zero average value, the noise and signal are integrated. The integrators are periodically dumped, and output examined. Phase lock synchronization tells when a zero or one will probably appear. A Barker word is used to detect when data frame is in and out of synchronism.

Observatory Operation

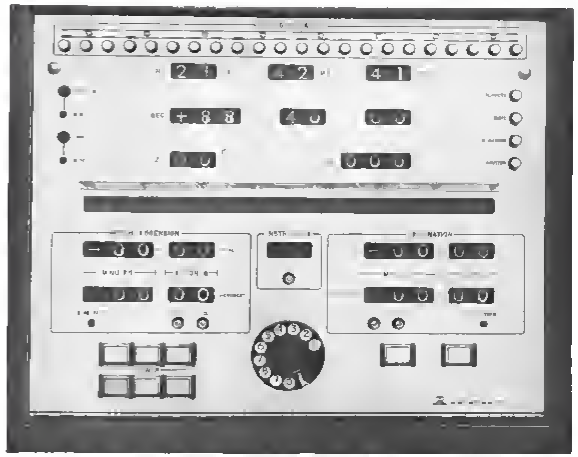
At the observatory end, 30 channels of telescope response data including direction telescope is pointing and its sensory response are multiplexed into an 11-bit straight binary analog-to-digital converter, transmitted serially to ground station.

At the ground station, the computer analyzes data from and provides directions for the telescope. It communicates with the control center asynchronously through a 22-bit high speed buffer register, according to Astrodata. This register, the company explains, will accept parallel binary information from the control center equipment in parallel. The output of the buffer in turn goes to one of eight paralleled 22-bit output registers. All of the registers are under computer command.

A sidereal clock, mounted in the control center rack, counts one pulse per sidereal second signal, provides a source of star time for use within the computer. This is necessary as star charts are mapped according to sidereal time (366.242 days per year contrasted with 365.242 days per solar year).

WWV signals picked up by a wideband receiver will synchronize the clock.

A control console associated with the system continuously displays position of the telescope and contains a telephone dial which permits operator to enter any desired changes. In addition 17 decades of unassigned digital displays may be programed to display any additional data secured from the orbiting observatory. Such observatory functions as the operation of the dome drive, shutter, and track motors are under operator pushbutton remote control.



CONSOLE of Astrodata control system will continuously display telescope's position. Telephone dial will permit operator to enter desired changes. Operator also can actuate dome drive, shutter and track motors by pushbutton remote control.

Recovered data—time of sidereal day and console commands are delivered to the computer, which decodes and displays them on the console. Data thus displayed would include star right ascension inclination, zenith distance and telescope azimuth, shutter status, etc.

Recovered data on telescope end is serially shifted through a 32-bit shift register and 16 32-bit patchboard controlled storage registers, which drive digital positional motors, are connected in parallel to it.

Hughes Builds Environmental Lab

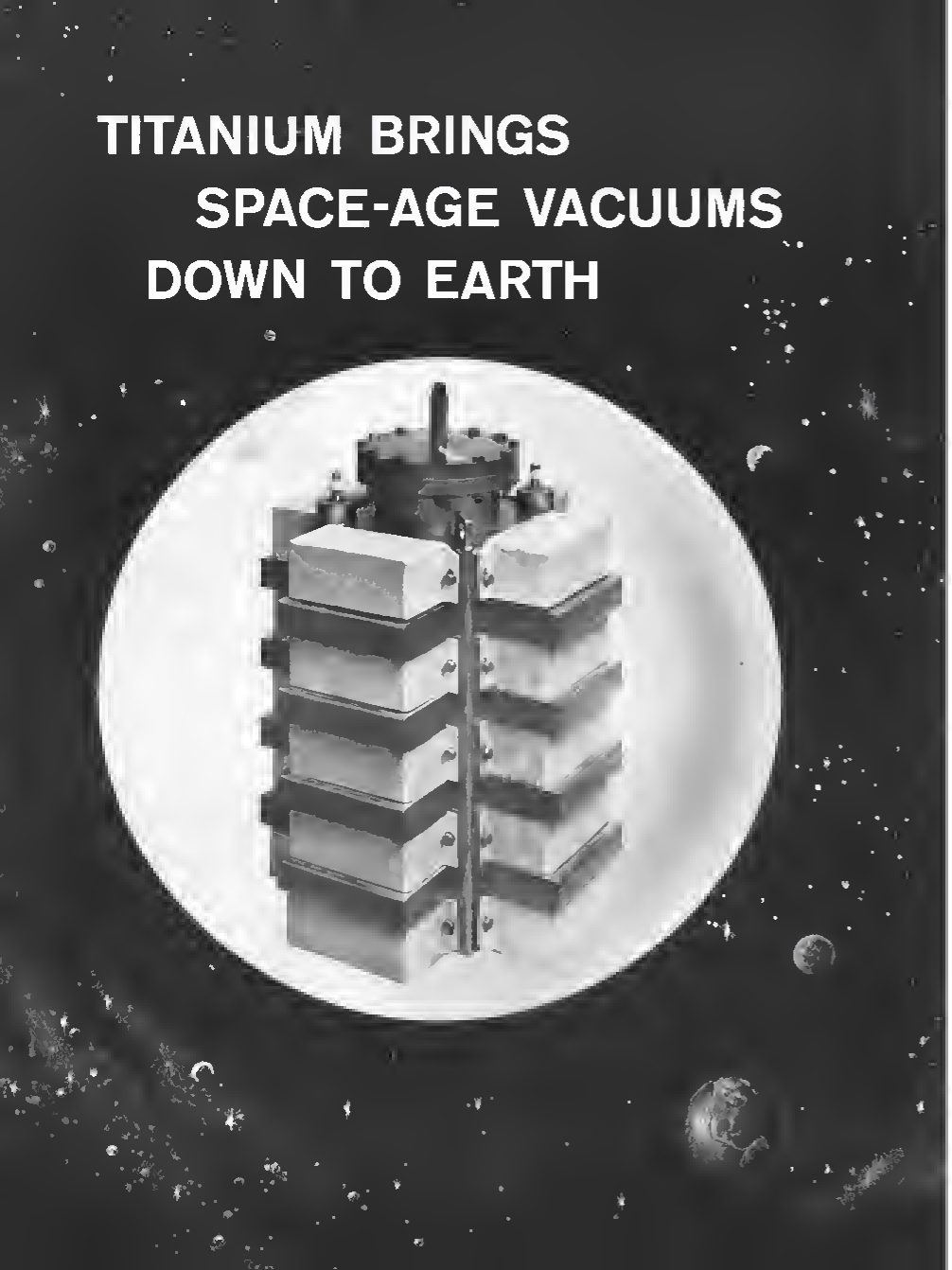
Surveyor moon exploration vehicle and the Syncom communications satellite will be among projects tested in a $6 million environmental laboratory Hughes Aircraft Co. expects to begin operating this month in El Segundo.

The laboratory to duplicate conditions on the moon and in space, will open with three test chambers, will add a fourth chamber, big enough to accommodate a full-size Surveyor, next February. There will be room for two additional chambers.

The laboratory will include solar simulators to reproduce the sun's radiation, will have high vacuum and thermal capability, and can duplicate conditions a spacecraft might experience in an earth orbit, en route to the moon, or on the moon. Temperature extremes of −320F and 275F can be produced.

Chambers will range in size from 6 x 6 ft. to 14 x 15 ft. in test volume. Walls can be cooled by liquid nitrogen. Overhead solar simulators can produce an intensity of 150 watts per square foot, slightly in excess of one solar constant, the intensity of the sun in space in the vicinity of the earth. Both carbon arc and mercury-xenon sources will be used, with some interchangeability among the chambers. The xenon simulators can be expanded to produce an intensity of the sun at Venus: 275 watts per square foot. One chamber can attain a pressure of 10^{-9} mm Hg, the other chambers attain 10^{-7} and 10^{-6} mm Hg. Diffusion pumping will be used, with provisions available for future addition of cryogenic pumping.

TITANIUM BRINGS SPACE-AGE VACUUMS DOWN TO EARTH



Republic Titanium plays a vital role in advanced electronic high-vacuum pumps produced by the Ultek Corporation, Palo Alto, California.

Attached to various size chambers, these pumps have proven ideal in extended space simulation. There are no moving parts. Pumps can operate unattended and require no refrigerants, oils, cold traps, water, or additional equipment.

Titanium plates (catbodes) are positioned next to the pump walls, on opposite sides of a stainless steel honeycomb structure (anode). A magnetic field is supplied by an external permanent magnet. High voltage applied between cathodes and anode causes continuous renewal of fresh, pure titanium surfaces which trap gas permanently.

Of all the commercially available metals, only titanium can perform this job. Pumps are designed to provide continuous contaminant-free vacuums in the range of 10^{-4} to 10^{-10} torr. In addition to space simulation, Ultek high-vacuum pumps are used in the manufacture of vacuum tubes and in the operation of mass spectrometers, gas analyzers, and other instruments.

One of the major suppliers of titanium, Republic leads the world in the production of alloy and ENDURO® Stainless Steels. Metallurgists help you select and apply the metals best suited to requirements. For information, contact your nearest Republic sales office. Please indicate if you would like a metallurgist to call.

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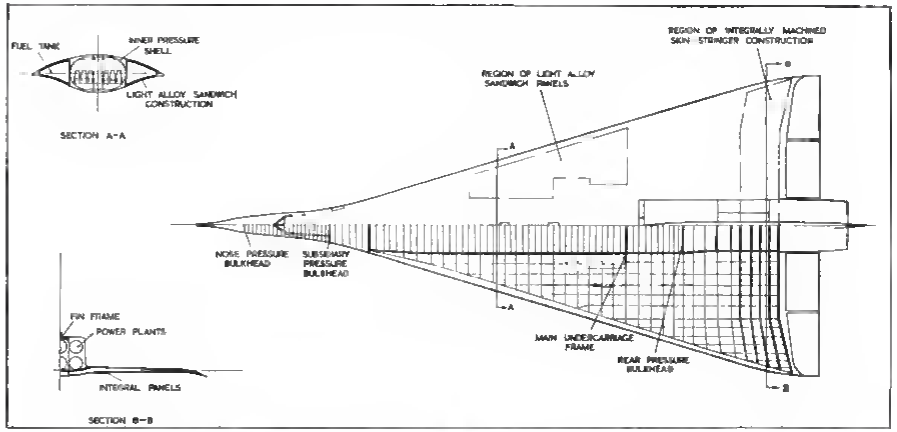


CRANFIELD PROJECT A-6B supersonic transport drawing shows location of pressure bulkheads. Shell arrangement for passenger cabin is shown at upper left. Location of four of the six turbojet powerplants is shown at lower left. The transport would have no windows.

British Design New Mach 2.2 Transport

By Herbert J. Coleman

London — Windowless supersonic transport featuring six buried turbojet engines and 73-deg. sweep slender delta wing has been designed by College of Aeronautics, Cranfield, for the Mach 2.2 range at speeds.

The airplane, aimed primarily at use on transatlantic routes, embodies the so-called integrated shape and includes unusual features of structural safety. Designers have concentrated on a configuration purposely different from those being considered within the British aircraft industry, such as the Sud Super Caravelle being studied as a joint Anglo-French project (AW Apr. 2, p. 26).

Discussing the design, Cranfield Project A-60, A. T. Newell, deputy head of the design department and D. Howe, department lecturer, told the Institution of Production Engineers that from a purely technical viewpoint, the Super Caravelle does not convincingly exhibit the characteristics of a successful supersonic airliner.

They pointed out that the true extent of supersonic booms is not yet known but that it may restrict supersonic airline operations to flight over unpopulated areas, adding: "In view of this, the choice of medium ranges for the Super Caravelle may prove to be unfortunate."

Development costs were estimated at about $300 million.

However, speakers admitted that Cranfield Project A-60 is far from an optimum design. Best external engine placement probably would be considered better than the buried configuration. Generally, the Cranfield design shapes up like this:

- **Delta wing** with curved leading edge in the region of tips and roots. Fuselage is 161 ft. long and fuselage depth is 10.1 ft., about the same as on the de Havilland Comet.
- **Six turbojet engines** of about 18,000 lb. thrust each are mounted in the rear fuselage, aft of the pressure cabin. Designers recommend some sort of underslung podded layout, such as used on the Super Caravelle (AW Jan. 1, p. 35), since engines could then be separately type-tested and more readily installed and serviced.
- **Gross weight** is 325,000 lb. and maximum landing weight is 190,000 lb. Airplane can carry 108 passengers over maximum range of 3,250 naut. mi. with seat pitch of 40 in., for reduced range, load of 126 passengers with 33 in. seat pitch is possible.

Newell and Howe said the integrated layout makes high cruising efficiencies obtainable, but at the same time, it becomes difficult to supply cabin windows although their absence can reduce structure weight by 2,000 lb. Lack of windows helps ensure pressure cabin integrity, but the speakers said the psychological problem is debatable. They said supersonic flying is for the sophisticated and interior television could alleviate tendencies toward claustrophobia.

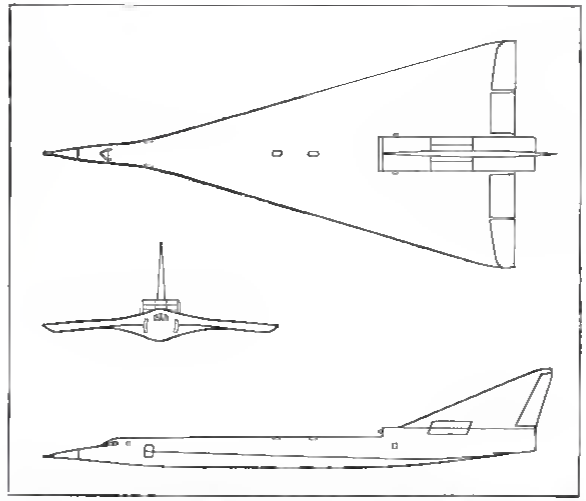
Cruising altitude would be from 57,000 to 65,000 ft., which would avoid bad weather conditions and minimize ground level sonic booms.

The Cranfield design team selected the slender delta wing planform because it met both high and low speed characteristics. In Great Britain, a similar wing is now being tested on the Handley Page 115 (AW cover, Sept. 18, 1961) and an ogee wing similar to the Super Caravelle's is being fitted to a Fairey FD.2 in Bristol Aircraft.

For safety reasons, designers centered on a triple bubble inner shell to withstand full pressurized cabin stresses with the inner shell giving a reserve factor should the inner one fail in any way less than catastrophically. Also, use of the buried engine layout implies a deep fuselage thus providing structural strength where the wing is thin and providing high stiffness to meet aeroelastic requirements.

Newell and Howe emphasized that wing construction envisaged is no different from that of subsonic aircraft, but they suggested light alloy honeycomb sandwich is desirable for structure in some of the fuel tank regions. Major problem, they continued, is the center wing fuselage unit, which ideally should be assembled as one component.

In materials since leading edge tem-



SUPERSONIC TRANSPORT designed at Cranfield College of Aeronautics would be 164 ft long with a 77 ft wingspan. Fuselage depth would be 10.1 ft. Rectangular intakes for six buried turbojets (13,000 lb. thrust each) are below vertical stabilizer. Note curvature of wing leading edge, absence of windows in passenger cabin. Air intakes would have movable shock ramps to vary throat area.

perature should not exceed 130C, most common metal likely would be light aluminum alloy specification RR 58. Engine intakes reach higher temperatures, and because of their rectangular shapes and the high pressures involved, a steel or titanium construction would be needed. In addition, the thick boundary layer associated with a semi-buried engine layout can cause considerable drag penalty and must be removed by ducting.

For air intakes, the Cranfield Project A 60 employs movable two-dimensional shock ramps which vary the throat area, automatic operation in the flight regime is necessary. Newell and Horre stressed that a combination of long, variable, rectangular air intakes with convergent-divergent nozzles suggests the need for considerable design skill to achieve an acceptable powerplant weight.

Autopilot Changes Ease B-52 Refueling

Pilot workload during air-refueling and low-level missions of the Boeing B-52 bomber can be reduced more than 50% by autopilot modifications to the Sperry Phoenix equipment now used on the intercontinental jet bomber, Boeing's Military Aircraft Systems Division, Wichita, Kan., estimates.

The revised autopilot system, developed by Sperry Phoenix in conjunction with the airframe manufacturer, currently is being flight evaluated by the Air Force. The B-52's Sperry Phoenix autopilot now has three additional components to handle electro-mechanical yaw-damper augmentation, column and wheel steering and boom steering.

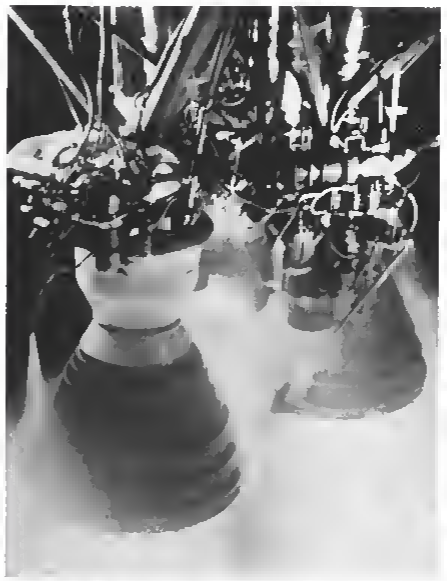
The modifications sharply reduce yaw oscillations during the tight formation flying necessary for aerial refueling and permit the pilot to put commands through the autopilot while the equipment stabilizes the receiver airplane in the airspace envelope.

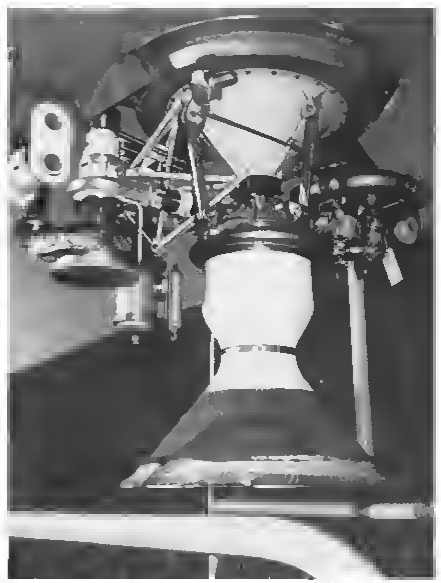
Boom steering is provided when the tanker's flying boom is inserted into the B-52 receptacle. A mechanical boom sensor is provided at the intake point of the receiver. When the boom travels as a result of aircraft movement, the sensor signals the autopilot to correct the receiver plane's flight path. The B-52 pilot may alter the boom angle as desired to change the airplane's relative position, but he primarily flies by the throttles to control speed during refueling.

The improved autopilot system incorporates modifications that overcome the equipment's previous tendency to disengage in turbulence at low altitudes. Elimination of this disengagement permits operation at low altitudes at less fatiguing control force levels.

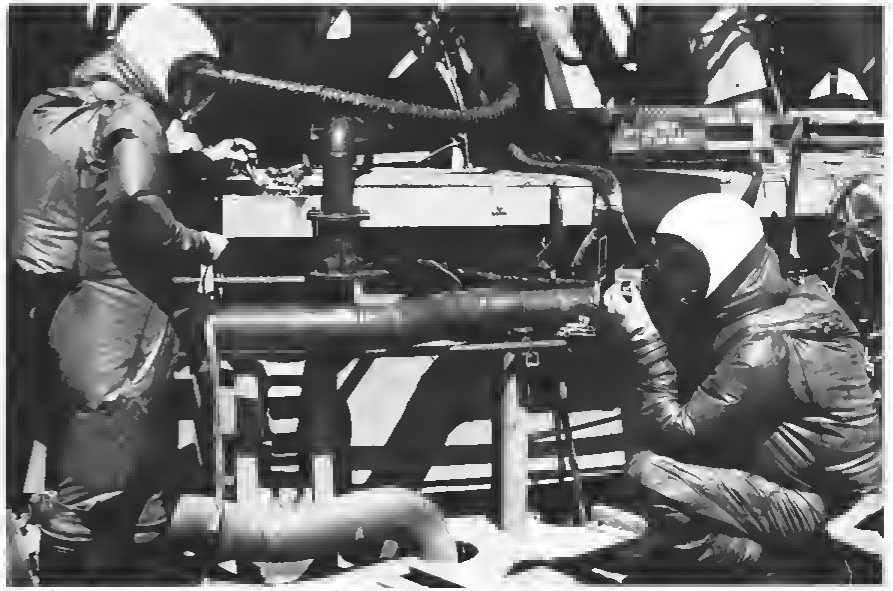
Titan 2 Success Boosts Space, ICBM Capability

USAF/Martin Titan 2 ICBM is readied for first full-range flight down Atlantic Missile Range, above left. Lift-off photo, above right, shows flame pattern from twin barrel, pump-fed Aerojet-General XLR-87-AJ5 first stage engine with design launch thrust of 430,000 lb. Titan 2 has non luminescent, pale pink flame with virtually no smoke, in contrast to Titan 1 flame which is yellow white and produces smoke. Pad weight of Titan 2 (SM-68B) is approximately 300 000 lb. ICBM version has 6,300 stat. mi. range. With increased tankage for space use, missile will boost 6,000 lb. Gemini two man orbital vehicle.





Test firing of first stage engines, above left, shows configuration of thrust chamber skirt. Second stage XLR-91-AJ5 engine, above right, has shorter skirt for out-of atmosphere operation. Storable hypergolic propellant is Aerozine-50 and nitrogen tetroxide.



Pressurized, air-conditioned butyl-coated cotton fabric safety suits protect fuel loading crews on Titan 2 gantry.

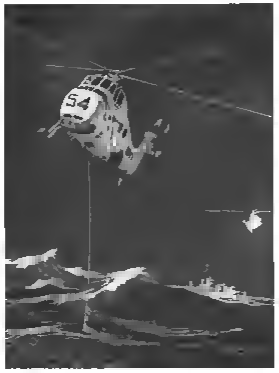
USAF/Boeing B-52H bomber carries four mockups of late configuration Skybolt air launched ballistic missiles during development flight from Wichita, Kan. B-52H, now being delivered to operational SAC units, has eight Pratt & Whitney TF33-P-3 turbofan engines. Note tail armament of single General Electric M-61 Vulcan Gatling gun.

B-52H to Launch First Live Skybolts

Boeing B-52H is expected to conduct first live firing of prototype Douglas Skybolt air launched ballistic missile this month. Live launches of operational-type Skybolts are scheduled to begin in November and first operational squadron is expected to be in service in November, 1964 (AW Apr. 9, p. 23). Pratt & Whitney TF33-P-3 turbofan engines and increased fuel capacity of integral tank wings gives the B-52H an unrefueled range of more than 12,000 statute miles. Missiles are suspended on inverted Y-shaped pylons inboard of engines beneath wings. Electric blanket keeps solid propellant warm at high altitude. Note anti-radiation paint covering entire aft section of fuselage possibly to protect electronics countermeasures equipment from radiation effects.

Aerial refueling, shown below, is possible with Skybolts aboard. B-52H carries full internal load of bombs and decoy missiles in addition to Skybolts.

SURVEYOR SPACECRAFT—*Ryan Electronics was selected by Hughes Aircraft Company, Inc., to design, develop and fabricate the Radar Altimeter and Doppler Velocity Sensor equipments for this NASA/JPL Lunar Soft Landing System*



ANTI SUBMARINE *defense is facilitated by Ryan Doppler Navigation Systems which make possible accurate, continuous all-weather navigation over land or sea, anywhere in the world, without any outside navigational aids*

TACTICAL AIR MOBILITY *and support are supplied by low speed, low altitude, fixed wing aircraft and helicopters. Ryan Doppler Navigators provide the precise navigation required for such tactical and support missions by any aircraft*

How to navigate *"on the deck"* at supersonic speeds?

Most practical answer yet devised: the new Ryanav IV Doppler Navigator developed by Ryan Electronics!

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Acknowledged leader for over 14 years in the design, development and large scale production of Doppler navigators, flexible, fast-moving Ryan is also making significant contributions in other areas of the space age.

Ryan, for example, is now building the newest concepts in vertical take-off aircraft. And today, as for years past, Ryan is the major supplier of advanced jet target drones for all the Armed Services. Among other Ryan activities are Flex Wing applications, electronic systems for lunar landings, and structures for space vehicles.

Ryan Electronics includes the most modern and best equipped facilities for electronics development, manufacturing and testing. And at Ryan Electronics and Ryan Aerospace, technical and management capabilities are designed to assure compliance with the most stringent standards.

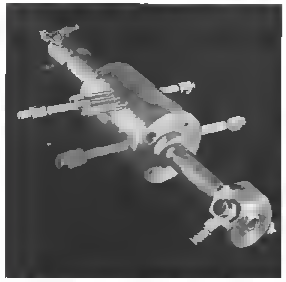
RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA

RYAN
ELECTRONICS

NEW AEROSPACE PRODUCTS

High-Voltage Air Heater

Manufacturer says the device, designed for use in wind tunnel tests of aerodynamic materials and components, simultaneously provides 50 60% power input conversion to useful heat, operating pressures up to 1,500 psi., operating runs up to 15 min duration, less than 0.1% air contamination by weight and two to three times more air than heaters of comparable efficiency



The equipment, designated Plasmare HV (High-Voltage) Air Heater, operates with air rather than inert gases or nitrogen. The heater is available in four sizes, corresponding to nominal power input ratings of 60, 250, 1,000 and 4,000 kw. It operates in the range of 300 to 25,000 v. at currents of 50 to 1 500 amp.

Heater operation features introduction of air into a central swirl chamber to form the desired flow pattern. The arc strikes from the inner wall of the rear hollow electrode to the inner wall of the nozzle electrode to create a plasma mass. A constricting nozzle increases pressure and flow velocity of the plasma. The heater creates temperatures from 4,000 to 12,000 deg Rankine.

Electric Welding Dept., Linde Co., Division of Union Carbide Corp., 270 Park Ave., New York 17, N. Y.

Missile Squib

Low-voltage device was developed for use in rocket motor ignition and pressure actuation.

The squib meets all Atlantic Missile Range safety requirements for missile ordnance components, the manufacturer says. Accidental application of one amp ere or one watt from circuit pickup or electromagnetic sources will not fire the squib or degrade its performance.

Sunnyvale Branch, Librascope Division, General Precision, Inc., 670 Arques Ave., Sunnyvale, Calif.

Space Simulator

New environmental simulator is reported capable of achieving vacuums of 10^{-9} mm mercury and better. Wall temperatures can be controlled at any level from −100 to 400F with mechanical refrigeration and electrical heaters.

Simulator chamber is available in three sizes—18 in. dia. x 36 in. deep, 30 in. dia. x 48 in. deep, or 48 in. dia. x 72 in. deep. Temperatures below −300F can be obtained by using an optically opaque baffle cooled by liquid nitrogen. Baffle is available as an accessory along with automatic controls for programing intermediate altitudes, controlled leakage and solar simulation equipment.

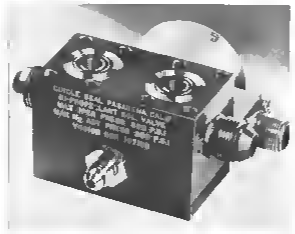
Envirotron Co., 7649 San Fernando Rd., Burbank, Calif.

Mobile Test Bench

New bench is designed to cut instrument checkout and calibration costs by bringing test equipment to the aircraft or missile, eliminating the need to send instruments back to a depot.

Bench will carry 632 lb. of test gear, and a removable cover can be attached to the rear to provide shelf space and electrical outlets. The bench is constructed of aluminum skin bonded to ½-in. plywood. Dimensions: 59 in. long x 41 in. wide x 40 in. high. Collapsible wings permit storing of the bench in minimum space. Three shelves are installed for mounting electronic test equipment. Running gear is retractable by operation of a jack handle, with a self-locking device for holding in retracted position.

White Division, Inc., Zero Mfg. Co., Palmer, Mass.



Bi-Propellant Control Valve

Fast-acting, high response valve was developed for directional control or maneuvering of rockets and space vehicles. Manufacturer reports tests of the valve have shown response times under 5 milliseconds from electrical signal to full open or full close. The device designed to operate under normal acceleration and vibration conditions, is capable of operating at 100 cycles/sec without valve float.

Pilot principle utilizes nitrogen or other inert gas in the system pressure, working with this pressurization rather than against it. The valve has a burst pressure of 1,600 psi with simultaneous pressurization at all external ports.

James Pond & Clark, Inc., 2151 E. Foothill Blvd., Pasadena, Calif.

Slide Rule

New device offers expanded computing capacity, the manufacturer claims with 26 scales, greater consistency and logic, convenience and speed in operation and lifetime durability.

The Dem-Lon rule incorporates a new proximity grouping of scales, additional calibrations, extended use of color coding and a redesigned indicator for easier manipulation. The indicator has a red hairline for greater contrast against black graduations.

The company says the device is completely shatterproof and immune to humidity variations, warping, cracking and sticking. The rule comes in a chamois-lined leather carrying case. A manual accompanying the device contains instructions for finance calculations.

Keuffel & Esser Co., Hoboken, N. J.

If
you
don't have
money
to burn

What's the *true* cost of a faulty fire detection system? It's the sum of lost flight time . . . extra maintenance . . . frayed tempers . . . loss of passenger good will. And each, in itself, is a troublesome, trying problem for profit-conscious airlines.

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MMRBM Guidance Challenges Industry

By Philip J. Klass

Washington—Choice of guidance technique to be used in the mobile medium-range ballistic missile (MMRBM) and its transporter launcher, from many possible alternatives, will determine the flexibility of the weapon's use, its payload, accuracy, cost and reliability

Microelectronic fabrication techniques appear mandatory to achieve a guidance package size and weight which will not penalize the missile's range and warhead size, according to observers close to the program

Present estimates are that a packaging density of 100,000 components per cubic foot will be required This is 10 times the density of the guidance package for the Air Force's Skybolt air launched ballistic missile, which currently has the highest component density of any ballistic missile under development

The MMRBM guidance problem involves techniques for precisely locating the missile launch site and azimuth aiming point as well as guiding the missile after it has been launched The two aspects are interrelated because the choice of technique used in the missile or transporter-launcher limits the techniques available for the other

The choice also is complicated by the fact that the MMRBM is to be designed to permit missile launches from ships as well as from land-based transports Some Defense Department officials are inclined to believe that ship-based launch may ultimately prove the more feasible for a variety of reasons

One is the belief that water-based launching platforms would be less vulnerable to sabotage than transports operating over West European highways Another is that water-based launchers would be less conspicuous and therefore less likely to provide a symbol which Communist or neutralist propagandists could use to create public opposition in some West European countries

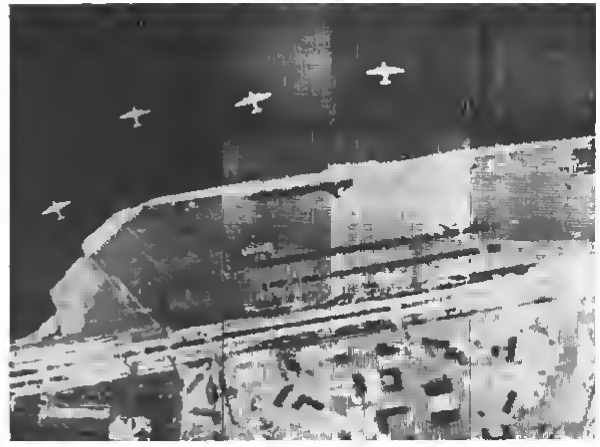
Here are some of the possible design approaches to MMRBM guidance under consideration for the land-based version of the weapon

• **All-inertial missile guidance** with no guidance aboard the transporter This would require the transporter to proceed to the nearest launch site whose location had previously been precisely surveyed Additionally, the launch site would contain a precisely surveyed azimuth reference While this approach involves the least complexity for both missile and transporter, it runs the risk that the transporter might be blocked from reaching a launch site by bomb damage or sabotage. Additionally, it would require a permanent continuous guard at launch sites to assure their integrity and prevent sabotage of the azimuth reference benchmark

• **North-seeking gyro** on transport and all inertial missile guidance The gyro would provide an azimuth reference for the missile and eliminate the need for a precise reference at the launch site and a 24-hour guard at the launch sites However, the north-seeking gyro would require 10-20 minutes to establish a reasonably accurate azimuth reference, and the transporter still must proceed to the nearest launch site to fire its missile

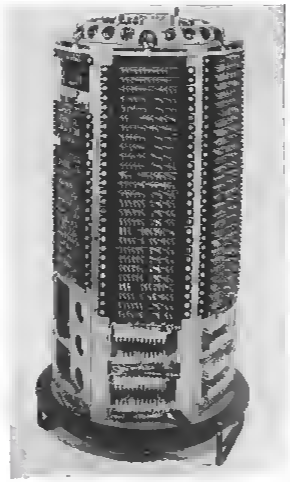
• **Inertial-stellar missile guidance**, using a single star tracker aboard the missile to determine azimuth bearing, with no guidance aboard the transporter This avoids the delay involved when a north-seeking gyro is used to establish azimuth reference, but adds weight, complexity and cost of a star tracker to the missile It also requires a precision optical window in the missile and the addition of roll stabilization to assure that the star remains within view of the tracker The requirement that the transporter proceed to a pre-surveyed location to launch would remain

• **Inertial missile guidance** with transporter equipped with an inertial navigation system This approach would enable the transporter to know its precise geographic location at all times and avoid the need to proceed to a pre-surveyed launch site, permitting much faster reaction time However, the transporter also would need a north-seeking gyro to establish azimuth reference, with settling time delays previously cited Or the missile would require a single-star tracker to determine azimuth during boost phase To prevent large accumulated drift errors in the transporter's inertial navigation system, it would be equipped with a fifth wheel to measure distance traveled to provide a continuous correction of the transporter inertial system The accuracy of such a fifth-wheel type odometer, particularly on bumpy roads, is a current unknown An alternative would be to pre-survey a number of points along regular transport routes which could



System Scans, Stores and Reprints Photo

Composite aerial photograph, the right-hand portion of which has been scanned, stored in a digital computer and reproduced by computer print-out device, demonstrates new technique under investigation by Cornell Aeronautical Laboratory for possible use in automatic photo-interpretation and target recognition Under Office of Naval Research and Bureau of Naval Weapons sponsorship, CAL has constructed facility for scanning a photograph with 100 lines per inch resolution, converting it into 16 levels of darkness (grey) in binary form suitable for storage in an IBM 704 computer Contents of a 5 x 5 in. picture can be scanned and stored in 90 sec.



ATC Data Link Unit

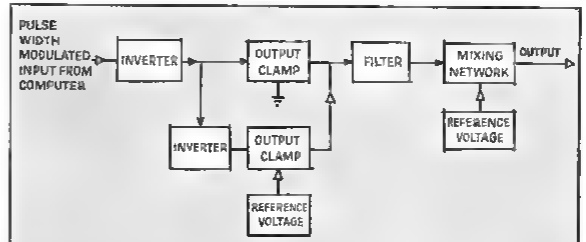
Data transmission system, a ground-to-ground digital data link and airborne digital-to-analog converter unit, has been developed by General Electric Co., Ltd., Coventry, England, for air traffic control application. After conversion from digital to analog form, instructions to the aircraft can be displayed on instruments or can be coupled directly to the aircraft's autopilot.

be used periodically to re-set the inertial system.

▪ **Inertial-stellar missile guidance** using two star trackers with no guidance required in the transporter. Such a system would involve an inertial platform large enough to stabilize two star trackers which would be designed to lock onto two prescribed stars during missile boost phase. From measurements of azimuth and elevation angles of the two stars relative to the horizon established by the stable platform, an on-board computer would calculate the missile's geographic position, compare this with the position it should have to hit its intended target and initiate steering signals to alter the missile's course as required.

The use of this two-star stellar-inertial guidance system in the missile would provide the ultimate in operational flexibility, since the missile could be fired from any location and the transporter itself need not carry any navigation equipment. However this system involves many techniques which have not been tried and will require extensive tests to fully establish its feasibility, most observers believe. For example, except for the subsonic Snark cruise-type missile, there is relatively

SKIRMISH OVER A COMPUTER-TO-INERTIAL-PLATFORM INTERPRETER



NAVIGATION BUFFER CIRCUIT

What is the best way to implement the digital-to-analog conversion circuitry required to convert binary incremental signals from a digital computer to precise d-c voltages for gyro torquing in an airborne tactical data system? This was a problem faced by Litton data systems engineers.

Several engineers who had participated in the development of an earlier navigation buffer employing the digital servo technique were strongly inclined towards playing it safe by adopting an identical approach. To permit the navigation system to sustain the longer flights required under the new program they proposed engineering greater accuracy into the existing buffer. Somehow, they felt, the additional requirements for lesser weight and volume could also be met. Preliminary investigation revealed that this scheme would require at least 20 pounds of hardware.

Feeling that a better way could be found, other engineers studied alternate approaches and finally proposed a scheme for generating d-c gyro torquing voltages scaled according to width-modulated pulses linearly related to computer word length. This approach appeared to hold promise of an accuracy of at least 1 part in 4000 (0.025%), which was specified for two of the required eight signals (six for the inertial subsystem, two for the cockpit display system). The pulse width modulation/demodulation method also appeared to require far less hardware than would the digital servo technique because of the elimination of heavy electromechanical components.

Skeptics were quick to point out that the specified precision would be impossible to obtain in view of errors inherent in pulse-width modulation, delays and rise times in the precision switch, switch offset voltage, reference supply voltage, filter capacitor leakage and stability, filter lags, drum speed variation, and signal line ground currents.

Undaunted, the advocates of the new method pressed ahead, conducted detailed studies and laboratory investigations to nullify all objections and verified the complete feasibility of their proposed scheme.

Now functioning as part of a tactical data system installed in a carrier-based aircraft, this eight-signal navigation buffer is packaged on five 3" x 3" cards and two small assemblies. Weight and volume are about one-fifth of that required for a digital servo type of buffer. More recently, new packaging techniques have enabled reduction of the buffer unit by an additional 40% to two cards and two assemblies without degrading accuracy.

Litton management recognizes the value of results stimulated by healthy controversy. Security and proprietary restrictions preclude our discussing current activities, but new programs offering many new technical challenges are now being conducted. And Litton continues to encourage an environment in which engineers can propose and pursue other than safe approaches to problems. If you've been frustrated in your attempts to follow through on new approaches to digital data handling and display functions, write H. G. Laur, Litton Systems, Inc., Data Systems Division, 6700 Eton Avenue, Canoga Park, California, or telephone Diamond 6-4040.

An Equal Opportunity Employer

Avco Tests 3-D Display System

Three dimensional dynamic situation display for radar, air defense or traffic control permitting 360-deg azimuth viewing, has been developed by Avco's Electronics and Ordnance Division Technique resembles earlier one demonstrated by ITT Laboratories (AW Oct 31, 1960 p 66), using a rotating screen except that Avco uses an electroluminescent panel to create display instead of cathode ray tube projector. The Avco approach permits multiple-color display all solid state construction and eliminates optical projection equipment Azimuth position of target displayed is determined by time that electroluminescent panel is energized Panel rotates at speed of 20 revolutions per second.

little experience in the use of a two star stellar-inertial system which must automatically seek out two prescribed stars in flight and lock onto them

The problem is far more difficult in a ballistic missile than in a cruise type of vehicle operating at subsonic speeds The star trackers must have an optical window for viewing which can withstand the rigors of transport over rough roads and missile launch yet provide an undistorted line of sight Some observers say that it would be a year or more before equipment could be built and tests could be conducted in an existing ballistic missile to establish the feasibility of this approach.

The use of a single star tracker to establish azimuth in flight also requires a good optical window but the requirements are not nearly so difficult because a smaller window will suffice and measurement is made only in one plane not two as with the two-star system

Additionally the two-star stellar inertial system will require a more complex computer on board the missile, and the overall missile guidance system will be heavier larger and more costly than some of the previously cited alternatives This might reduce missile warhead size and/or missile range, seriously compromising the usefulness of the weapon

The increased complexity of the two star approach almost certainly means that the weapon will be less reliable than if the all inertial type guidance is used But the important question, assuming the concept is feasible is how much would reliability suffer

The freedom of being able to launch the missile from any location without need to proceed to a preselected launch site which may be blocked might enable the two star guidance to put more warheads on target than the less complex type

But the guidance approach that appears optimum for a land based MMRBM is not necessarily optimum for a ship based system There is less likelihood of a water based launcher being blocked from preserved launch sites But the ability to proceed to such a site may require visual sighting from the ship at a time when nearby landmarks are obscured by adverse weather

These are but a few of the many unresolved questions on the MMRBM program which have prompted the office of the Director of Defense Research & Engineering to insist that the Air Force contract initially only for a "program definition phase" prior to awarding contracts for hardware development (AW Apr 2 p 22)

Some Air Force officials strongly favor the use of the two star stellar inertial guidance system but there are divergences of opinion within USAF

Three companies currently hold Air Force contracts for a study of the MMRBM guidance problem, under the code name of STINGS (Stellar Inertial Guidance System) These include

• AC Spark Plug Division of General Motors Corp has been studying a single star stellar-inertial missile guidance system in which star tracker is used to establish azimuth reference The system is adaptable to the two star configuration

• Kearfott Division of General Precision

PROBLEMATICAL RECREATIONS 115

Four cities, A, B, C, and D, lie at the vertices of a rectangle. Inside this imaginary rectangle there is a fifth city, E, which is exactly 33 miles from A and 56 miles from C. E also happens to be an integral number of miles from the other two cities, being further from B than from D. If the distance between B and C is three times that of E from D, how far, to the nearest half mile, is A from B? —*Contributed*

Cartography is a specialty of our Aero Service Division, the new Litton "flying facility" in Philadelphia. Aero has been engaged in air survey work since 1919. Other Aero services include aerial photographic analyses, aeromagnetic and other geophysical maps, geophysical interpretations, natural resources inventories and large area development studies.

ANSWER TO LAST WEEK'S PROBLEM. 9 miles from home. (He drives 15 round trips.)

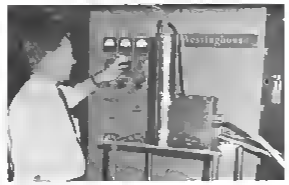
LITTON INDUSTRIES, INC.
Beverly Hills, California

Equipment Corp. also has been studying a single star stellar-inertial system, but one which employs a novel star tracker that has no moving parts. This static tracker is less adaptable to the two star configuration.

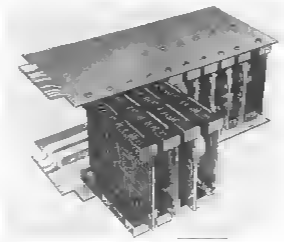
• **United Aircraft Corporate Systems Center** is studying a more advanced concept which uses two star trackers that would be employed during the free-flight portion of the missile trajectory. This requires the addition of means for changing trajectory during this portion of the flight.

Because of the potential size and importance of the MMRBM program and the number of inertial guidance manufacturers that have, or soon will have, excess engineering and factory capacity, the competition for the Air Force program is expected to be keen.

NEW AVIONIC PRODUCTS



• **Heavy duty optical maser,** Model HD-6, designed for experimental use in micromachining and welding, is now available from Westinghouse Electronic Tube Div. The pulsed type device includes power supply with a maximum energy storage capacity of 25,600 joules. Pulse rate can be varied from 0.25 to 12 pulses per minute. Maximum output power is 10 kw. Price is $25,000.



• **Beacon printed circuit connectors** in second Saturn booster are designed to withstand high shock and vibration. Connectors can be placed along any edge of printed circuit board. Group of boards is then interconnected by transverse printed boards which contact connectors and are secured to them with screws to provide an overall rigid structure. Manufacturer: Brown Engineering Co., Huntsville, Ala.

Marine Corps jet approaches launching speed with only 50 feet to go of 1000-foot catapult-assisted takeoff run.

PORTABLE AIRSTRIP:

BLISS CATAPORT SYSTEM "SLINGSHOTS" MARINE JETS ALOFT FROM SHORT RUNWAYS...CATCHES THEM ON LANDING

Bogue Field, N.C., April 14—The 2d Marine Aircraft Wing today successfully demonstrated to high government officials and the press the first operational version of a portable airstrip for forward area jet fighter operations in "brush fire" warfare. This system is dubbed SATS (Short Air Field for Tactical Support) by the Marine Corps.

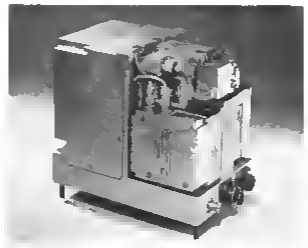
A key unit of SATS is the Cataport® System, developed by the E. W. Bliss Company, Canton, Ohio, in cooperation with the Naval Air Material Center, the Bureau of Naval Weapons and the Marine Corps. Cataport, a combination launching and recovery device that can be flown into forward areas and set up quickly, makes it possible to operate fast jet fighters from small air fields. A single compact unit provides for both launching and arrestment. To launch, a cable coupled to nylon tapes is attached to the aircraft in a "slingshot" arrangement. The "slingshot" is activated by rapidly winding the tapes on reels powered by turbo-prop engines.

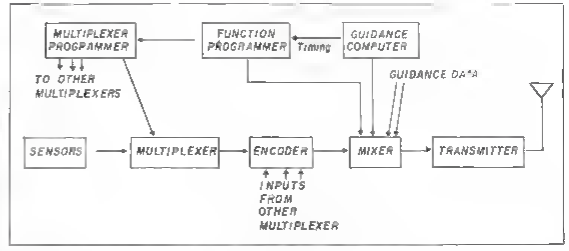
For landings, the jet engages the same cable stretched taut across the runway. As the tapes are pulled from the reels, friction brakes bring the aircraft to a controlled stop.

The E. W. Bliss Company has had a decade of experience in the development and manufacture of aircraft catapulting systems and overrun barriers for military uses. The company is also directing this experience to the commercial application of this equipment. For more information contact:

BLISS SINCE 1857

E. W. BLISS COMPANY
Aircraft Launching and Recovery Equipment Division
CANTON, OHIO





BLOCK DIAGRAM of Minuteman ICBM pulse code modulation telemetry system (right). System can sample up to 352 channels of test data, encode them and transmit information back to ground facilities. At left is the system's 15-watt, rugged RF transmitter, made by United ElectroDynamics, Inc., Pasadena, Calif. The compact transmitter weighs 10 lb.

Minuteman Telemetry Flight Test Due

By Barry Miller

Los Angeles—Lightweight, compact airborne pulse code modulation (PCM) telemetry system capable of sensing, sampling and transmitting 352 channels of ballistic missile test data is scheduled for flight on an upcoming Minuteman ICBM shot from Cape Canaveral.

The system has been assembled by Boeing Co., associate prime contractor for assembly, test and integration of Minuteman, from equipment supplied by several subcontractors.

During missile test flights, systems of this type are expected to be able to accurately sample such missile test variables as engine burning rate, temperature, vibration, gimbals angle accelerations and speed, as well the operation of the Minuteman's inertial guidance system.

System Capability

The Minuteman PCM system will be capable of multiplexing high and low-level analog signals eliminating the need for pre-amplification between sensors and multiplexers and making possible greater compactness, power savings and a reduction of noise problems. In addition, the insertion of substitute matrix cards in each multiplexer of the system permits selection of sampling rates and channels to meet needs of particular test flights.

A complete Minuteman PCM system consists of sensors, four multiplexers, a multiplexer programmer, an eight bit binary encoder, a function programmer to interleave data from the guidance computer with multiplexed transducer data and a PCM/FM telemetry transmitter. Two additional FM transmitters carried on the missile will transmit redundant data and provide capability for a limited degree of continuous monitoring.

Various types of high and low level sensors, transducers, thermocouples and strain gages will supply inputs to the four multiplexers, one in each of the missile's two down stages (stages other than the last one) and two in the instrumentation compartment. The modularly constructed multiplexers sequentially select data for routing to the encoder. The multiplexer programmer, located in the instrumentation compartment, controls triggering pulses, originating in the guidance computer for the four multiplexers and passes analog information through the encoder. The multiplexers and the multiplexer programmer are made by Radiation, Inc., Melbourne, Fla.

The system is so designed that as the initial stages of the test missile are separated or in the event a multiplexer is disabled, it will remain in operation as a multiplexer is separated with a down stage. The programmer, Radiation explains, directs power to each multiplexer and provides short circuit protection as the first two multiplexers are cut out.

Weight of the multiplexing system is less than 70 lb., packaged into a volume of less than one cubic foot.

Minuteman PCM permits a total of 352 possible analog channels to be sampled. Each of the first two multiplexers (in stages one and two) have 96 channel capability while the remaining two in the instrumentation compartment can handle 128 and 32 channels, respectively. This large number of available channels should boost the amount of test data that can be secured from any test launch.

Total maximum analog word rate will be 25.6 ke. A comparable pulse duration modulation (PDM), Radiation says, would have 330 channels and a total word rate of 9.9 ke. Specified accuracy of Minuteman data is 2% for 10-millivolt input signals, 0.6% for 50-millivolt signals, and 0.5% for 5 volt signals.

Flexibility is made possible by the use of exchangeable matrix cards in each multiplexer permitting reassignment of channel sampling rates in accordance with individual test missile needs.

Sampling rates vary between 33⅓ samples/sec and 800 samples/sec per channel and considerably higher by paralleling channels. Top rate for the 128 channel multiplexer, located in the third stage is 12,800 samples/sec; 3,200 samples/sec is maximum for the 32 channel multiplexer.

A total of 22 program cards contains matrices for a single fixed program. Technicians can make minor changes in the patterns; major changes require new program cards.

The flight system is designed for an operating lifetime of 500 hr. and is expected to achieve a reliability of 0.997% for 30 min. of preflight and 5 min. of flight time.

Transistors Used

In the multiplexing systems transistors rather than diode gates are employed for both high and low level signals. Transistor circuits enable switching impulses to be isolated from data and from low-level devices. Radiation points out. Bilateral use of transistors for different level signals cuts the number of required components.

The eight bit binary encoder for the telemetry system is an all solid-state voltmeter, made by the Autonetics Division of North American Aviation. It switches incoming signals into a comparator circuit in which they are compared to fixed voltage levels to get them into digital form.

A PCM/FM telemetry transmitter, which provides an output of 15 watts, will send multiplexed data back to ground. The transmitter is manufactured by United ElectroDynamics, Inc., Pasadena, Calif., weighs 10 lb. and is packed into a compact 223 cu. in. The

RF power output, according to the company, will be constant, within 2 watts, through input variations from 26 to 30 volts and an antenna VSWR of 2:1.

Telemetry transmitter package is designed to withstand extreme thermal transients for periods of four to six minutes without causing a degradation in the accuracy of the data. United Electrodynamics says. The transmitter is of hybrid design, using transistors in the RF exciter section and subminiature tubes in the RF power amplifier. The transmitter, the company says, is mounted to a heat sink of honeycomb aluminum block filled with nickelous nitrate which has heat absorptive characteristics that enable it to be a temperature control. In previous flights, a PAM-FM/FM system with 190 channel capacity was flown. A new wind PCM system was flown as a backup.

PCM is employed in Minuteman test flights and those of other ballistic missiles including Titan, for high accuracy sampling of large numbers of channels. Data is transmitted in digital form, sidestepping possible errors that might appear in analog frequency division multiplex systems.

One overriding requirement for the entire system was the need to protect equipment to enable it to survive severe environmental conditions experienced in missile launch and flight. Radiation reports its packages showed no degradation after being subjected to 10g sinusoidal and 0.5g²/cps random vibration combined in complex wave forms, in excess of twice specified vibration levels.

Besides its share in the flight PCM equipment, Radiation also supplies ground PCM/FM test systems for checking out telemetry and ground data processing systems for four centers.

Arinc to Automate Message Switching

Dallas, Tex.—Aeronautical Radio, Inc. (Arinc) is spending more than $2 million on a Collins Radio C-8000 electronic automatic telegraph message switching system to handle routine and priority messages from airline subscribers.

To be installed in Arinc's communications center later this year, the Collins C-8000 features dual solid state data processors, dual random access message files and magnetic tape for message storage.

Services include immediate cross office transfer to available teletype lines as message is received; selectible interrupt tone for priority traffic to ensure no-delay handling; no delay handling of multiple addresses and also programed logic control.

FILTER CENTER

▶**Target Seeker for Interceptor Satellites**—Air Force's Space Systems Division soon will begin a broad study program to investigate active electromagnetic target seekers, such as radar, that could be made available in several years for use by satellite inspector vehicles as a terminal guidance technique in rendezvousing with both cooperative and uncooperative satellites orbiting above the North American continent. The seekers could guide intercepting vehicles the final few miles to a target after ground based detection and tracking systems locate the target and predict gross interception coordinates. Among the more than dozen bidders for the program are Hughes Aircraft, Emerson Electric Space Technology Laboratories, Raytheon, Airborne Instruments, Sperry Rand and Westinghouse.

▶**Planetary Landing Altimeter Award**—Thirty day study of a 300,000 km range planetary radar altimeter (AW Mar. 5, p. 15) will be conducted by Wiley Electronic Products Co., Phoenix, Ariz., for National Aeronautics and Space Administration's Jet Propulsion Laboratory. Wiley makes the altimeter carried by NASA/JPL's Ranger vehicles.

▶**Processing Back-of-Moon Photos**—Avionics companies are being asked to submit proposals late this month for a Surveyor ground data handling system, which Jet Propulsion Laboratory is seeking, to digest video data return to the earth by a high resolution photographic system aboard the projected Surveyor lunar orbiter. The orbiter is intended to orbit the moon and map both back and facing surfaces. The ground system would reconstitute pictures, enhance images and store video. JPL soon will ask for proposals for the studies of orbiter's optical system (AW Apr. 9, p. 73).

▶**Air Force to Probe Future Avionic Needs**—Future Air Force avionic needs, in such diverse areas as command and control, global communications, ground and airborne instrumentation, as they are affected by increasingly complex weapon systems and aerospace military environments are expected to be examined in future industry studies to be sponsored by Air Force's Electronic Systems Division. Studies probably will center on needs in the decade from 1965 to 1975 and may carefully scrutinize ability of avionic systems to survive nuclear attack. ESD recently initiated one such "futures" planning study to be handled by three aerospace firms for advanced aerospace surveillance and warning systems (AW Apr. 2, p. 16).

▶**Dispute Over Laser Weapons**—Dispute may be taking shape among the interested services and in government agencies about best research directions to take in investigating feasibility and development of electromagnetic weapons using high energy beams of optical masers. Fourteen 45 day feasibility laser weapons studies by avionics companies for Office of Naval Research are due for completion early next month.

▶**USAF Seeks Exotic Power Sources**—Aeronautical Systems Division plans a number of new study and development programs in the field of exotic electrical power conversion generation techniques, including thermionic, thermoelectric, thermomagneto, magnetohydrodynamic, electrochemical and photoelectric. Companies interested in being considered must submit information on their capabilities by Apr. 25 to ASD, Wright-Patterson AFB, Dayton, Ohio, Attention ASRKNB. Other ASD requests for research and development sources with Apr. 26 closing dates:

- **Space vehicle attitude control** techniques with emphasis on long operational life, accurate control and efficient use of expended materials.
- **Flight control systems**, with specific emphasis on techniques for accelerated reliability verification, application of heuristic elements to improve reliability of ferro-electric, ferro-magnetic devices and molectronics techniques.

Cryogenic Magnet

Cryogenic magnet, capable of producing field of 50,000 gauss at —269C temperature, will be marketed by Westinghouse Electric Corp. System includes power supply and associated equipment. The superconducting magnet produces powerful field within its 1 in. inside diameter.

Ling-Temco-Vought Reports 1961 Loss

Dallas, Tex.—Ling Temco Vought which reported a $13 million loss for 1961, turned a profit in the first two months of 1962 and anticipates an improved earnings trend for the second quarter and beyond, despite research and development expenditures of $10 5 to $13 million planned for 1962

The 1961 loss of $13 158,591 included extraordinary writeoffs in excess of $13 million recorded at the end of the third quarter Sales for 1961 totaled $192,847,311

Chance Vought Corp and its subsidiaries are included only in the final four months of the 1961 combined Ling Temco Vought report

The new corporation, which entered 1962 with a backlog exceeding $300 million, noted that last year was a period of adjustment and consolidation and of review, decision making and action to effectively combine Ling Temco and Chance Vought into a coordinated enterprise In the course of shaking down the diverse operation, some subsidiaries and products have been disposed of L T V notes that although these had contributed some $45 million to annual sales their operations resulted in annual losses exceeding $4 million in addition to diverting management attention from more important goals Most of this reorganization has been accomplished, the report states The four major marketing areas considered as L-T-V's prime target embrace aerospace activities communications and sound systems military electronics and commercial and other products, the latter including such things as Army surface vehicles

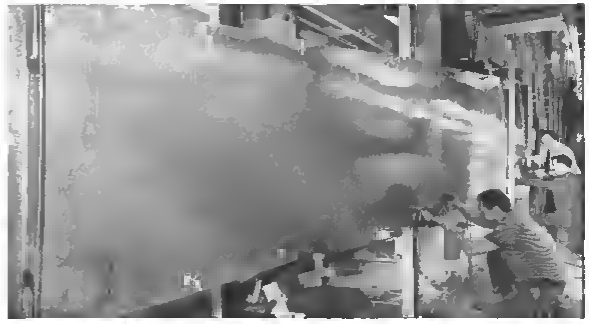
New Offerings

Electronic Specialty Co., Los Angeles Calif engaged in (1) the design development and manufacture of electronic systems and components, most of which are used in aircraft, missiles or satellites or in related ground support or control equipment, (2) research, development and consultation relating to the preliminary design and analysis of weapons, countermeasures and related systems, (3) the design and manufacture of tracking antennas and related equipment Offering is 480 000 shares of 50¢ par common stock and 480,000 shares of no par preferred stock to shareholders of Iron Fireman Manufacturing Co pursuant to the company's proposed acquisition, by merger of Iron Fireman Iron Fireman produces sensitive relays and displacement type gyroscopes, aircraft, missile and other miscellaneous machined parts requiring the use of metal working equipment; and heating equipment

Geotechnical Corp., Garland, Tex engaged in the organization and performance of research programs, the design development and manufacture of instruments and systems for the detection, recording and measurement of earth motion and the operation of facilities and field services Offering is 90.000 common shares, 80,000 shares for sale by the company, and 10 000 outstanding shares by William B Heroy, board chairman The company's proceeds will be used principally to increase working capital, except for approximately $60.000 which will be used to retire the outstanding preferred stock of the company

Turbodyne Corp., Washington, D. C., which proposes to engage in researching, developing and producing gas turbine engines, overhauling engines, and manufacturing certain other products Offering is 127,500 common shares at $5 per share Of the proceeds, $200 000 will be used for engine research and development, and the balance for repayment of stockholders' loans, investment in a new plant and production of proprietary products.

Loral Electronics Corp., New York, N Y., engaged in research, development and production of military products, principally electronic warfare systems and anti-submarine warfare systems, and in the fabrication and processing of beryllium and beryllium products for military use Offering is 56,225 outstanding common shares by the present holders



First Boeing 727 Wing Panels Assembled

Upper and lower wing panels (top and bottom photos, respectively) for the first Boeing 727 triple-turbojet transport are installed in assembly jig at the company's plant at Renton, Wash The full span panels are 55 ft. 7 in long and 7 ft 8 in wide at the inboard end, tapering to a width of 2 ft 5 in. at wingtip

POTEZ-HEINKEL CM.191 FOUR-PLACE TURBOJET trainer and liaison aircraft is built largely from Potez/Fouga Magister components.

BUTTERFLY V-TYPE TAIL configuration is retained from Magister. Rear view shows wide main gear tread and engine positions

German Order Expected for Potez-Heinkel CM.191 Jet

By Robert E. Farrell

Toulouse, France—Expected West German order for the Potez-Heinkel CM.191 should provide a production base for the four-place jet liaison aircraft in its attempt to capture civil sales.

West German government, which already has ordered three CM.191 flying prototypes as well as two aircraft for static testing, is expected later this year to order a minimum of fifty aircraft. Total order may go to 100 aircraft. German Defense Ministry wants to use the CM.191 for flight training and liaison missions.

Flight tests on the initial CM.191 prototype have been under way here in Toulouse since Mar. 19. Potez in charge of the aircraft's flight test program says aircraft is confirming estimated performance. The CM.191, powered by two Turbomeca Marbore 6 turbojets each delivering 1,060 lb. thrust, cruises at 380 kt. at 20,000 ft. with a range, assuming normal reserves and a 54 kt. adverse wind, of approximately 550 mi.

Heinkel, builder of the CM.191 prototypes and future recipient of West German order, would like to capitalize on its government support to develop civil sales. Though a French design, based on the successful Magister trainer, Heinkel has production and sales rights in most world markets.

The West German company will launch its civil sales drive by showing the CM.191 prototype at Hanover Air Show, Apr. 28. Basic sales price is quoted at $220,000. Heinkel hopes to keep the CM.191 price low and thinks it can do so since the aircraft is built out of Magister components. Nearly one thousand Magisters have been built.

Main design difference between CM.191 and Magister is the former's enlarged fuselage to permit side-by-side two-row seating in place of the Magister's tandem layout. Familiar Magister butterfly tail has been retained. Wing span is larger by two feet while wing area has been increased to 198 sq. ft. from the Magister's 186 sq. ft.

CM.191's gross weight of 8,135 lb. including 2,380 lb. of fuel, compares with Magister gross weight of 6,976 lb.

CABIN SPACING is evident from photo of test personnel preparing for flight. Rear seat is filled with test equipment for this flight.

CM.191 Specifications

Span	39 ft. 2 in.
Length	32 ft. 7 in.
Height	9 ft. 1 in.
Wing area	198 sq. ft.
Aspect ratio	7.8
Empty weight, equipped	4,785 lb.
Gross weight, including fuel	2,380 lb. 8,135 lb.
Propulsion	Two Turbomeca Marbore 6 turbojets delivering each 1,060 lb. static thrust

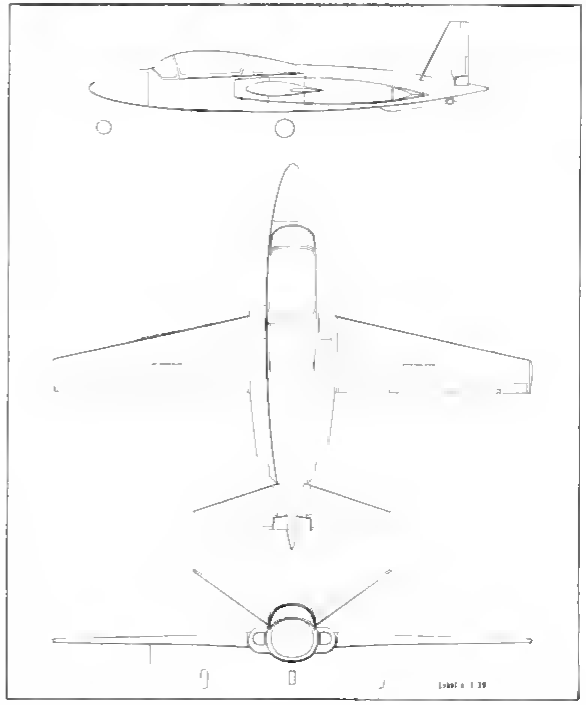
CM.191 Marbore Mark 6 power plants are more powerful than Magister's Marbore Mark 2s, which developed 880 lb. thrust each. Twin engine installation layout remains the same.

French company called Longa, now merged into Potez, proposed a four-place version of its Magister trainer in 1956. French air force, however, decided in favor of Morane-Saulnier's MS.760 Paris liaison jet so Longa dropped its project.

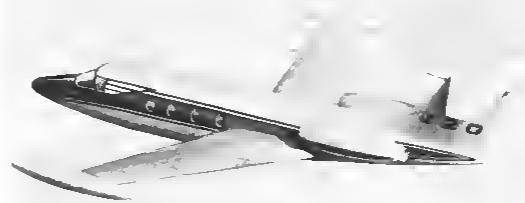
A year ago, when West German Defense Ministry indicated interest in a four-place jet liaison aircraft, Heinkel and Potez jointly revived the earlier project. Heinkel already was working with Potez on Magisters for West German air force. German government then put up the funds for prototype development.

CM.191 Performance

Maximum sea level speed	365 kt.
At 20,000 ft.	380 kt.
Cruising speed, sea level at max continuous power	330 kt.
At 20,000 ft.	350 kt.
Service ceiling	38,000 ft.
Range with 54 kt. adverse wind 22 imp. gal.	
Reserve at sea level	320 mi.
At 20,000 ft.	555 mi.
At 38,000 ft.	645 mi.
Takeoff distance over obstacle	2,985 ft.
Max. rate of climb at sea level	3,100 fpm
At 20,000 ft.	1,500 fpm.



THREE-VIEW drawing shows general configuration of Potez-Heinkel CM.191. Magister cabin has been enlarged to accommodate four persons.



New West Germon Turbojet Announced

Latest potential entry into the already crowded multi-engine executive turbojet transport field is the 9-to-14 place HFB 320 proposed by West German company of Hamburger Flugzeugbau GmbH Hamburg Most striking design feature of the aircraft is the forward swept wings Aircraft also will have tip tanks and high T-tail Powerplants presently envisioned are two Pratt & Whitney JT12A-6 turbojets of 3 000 lb thrust each mounted at the rear of the fuselage with the air intakes projecting above the upper surface of the wing Approximate HFB 320 dimensions will be 45 ft wing span a length of 50 ft and a height of more than 13 ft Range will exceed 700 mi with reserves Maximum payload will exceed 2 600 lb

U.S. Business & Utility Plane Shipments

January 1962

Make & Model	No. of Units	Net Billings
Aero Commander 680A, B	6	
560F	3	$1 316 000
680F	4	
Beech G18S	2	
33 Debonair	10	
35 Bonanza	10	
50 Twin Bonanza	2	$2,747 000
55 Baron	17	
65 Queen Air	4	
95 Travel Air	3	
Cessna 150	30	
172, Skyhawk	32	
175 Skylark	8	
180	5	
182 Skylane	85	$3 786 000
185 Skywagon	28	
210	25	
310	12	
320 Skyknight	5	
Champion 7EC Traveler	1	
7GCB Challenger	4	$45,000
7HC Ox-er	2	
Lake LA-4 Skimmer	1	$20,000
Murray Mark 21C	21	$392,000
Piper PA-18-95 Super Cub	1	
PA 18-135 Super Cub	10	
PA-22 108 Colt	30	
PA 23 [illegible] Apache	6	
PA 23-250 Aztec	5	$2,683,000
PA 24-260 Comanche	12	
PA-24-250 Comanche	53	
PA 25-150 Pawnee	17	
PA 28-140 Cherokee	10	
PA 28-150 Cherokee	58	
Totals	866	$10,676,000

Note: Above compares with 869 units having a total net billing value of $12,216 000 shipped from factories in January 1961. Early 1961 shipments were unrealistically high due to excess field inventories of new and used aircraft and not last year's business recession. Much inventory has since been disposed of and shipments are closer in line with probable sales During early 1962 indicating a much healthier situation for factories and retail outlets than was the case last year

PRIVATE LINES

Total sales of $31,809,677 were reported by Beech Aircraft Corp., Wichita, Kan., for the first six months of its current fiscal year with net earnings of $1,363,616, equal to 49 cents per share for the period ending Mar 31 Total sales of a year ago in the same period were $36 799,770, also 49 cents a share adjusted for stock dividend Beech President Mrs. O. A Beech, noted that initial delivery contracts exceeding $15 million are now being negotiated with the Navy for quantities of the KD2B-1 supersonic target

Full-scale glass fiber skin fuselage and stub-wing mockup of the Swiss-built SAAC 23 executive twin-jet is being built by Howard Aero, Inc., San Antonio Tex., and will be displayed at Reading Aviation Service's Annual Business Aircraft Display and Forum, Reading Pa. municipal airport June 8-9 Mockup of the SAAC 23 twin-jet will include fuselage forward of rear pressure bulkhead and have fully furnished cabin and cockpit

National Defense Agency of Japan has purchased three Beech Model 65 Queen Air aircraft for use as air crew navigation trainers and personnel transports by the Japanese Maritime Self Defense Force Beech officials in Tokyo said the order represented the first production quantity with other orders expected to follow Total defense agency order for the Beech Queen Air may exceed $6 million

Piper deliveries in February totaled 191 units having a total factory net billing value of $2 504 407 Included were 11 PA-18-150 Super Cubs, 24 PA 22 108 Colts, 1 PA 22 150 Caribbean 3 PA-23 160 Apaches, 8 PA-23-250 Aztecs, 12 PA 24 160 Comanches, 42 PA 24-250 Comanches, 16 PA 25-150 Pawnees, 16 PA 28-150 Cherokees and 58 PA 28 160 Cherokees

Beech Aircraft Corp., which recently acquired its Houston, Tex. distributor, Business Aircraft Inc., to maintain the operation which has experienced two management changes in the past several years appointed Stewart M Axton as president and general manager Axton is moving to Houston from his former post as vice president general manager of Atlantic Aviation Corp.'s Atlantic Aviation Service Division Philadelphia, Pa Business Aircraft is undergoing reorganization and improvement of its facilities at Houston International Airport

British Aviation Procurement Criticized

London—British Ministry of Aviation was sharply criticized recently by Viscount Caldecote, deputy managing director of the British Aircraft Corp., who called for competent long-range planning between ministry and the government.

Speaking to the Institution of Production Engineers at the College of Aeronautics, Cranfield, Lord Caldecote broadened his criticism to include the post of Minister of Aviation now held by Peter Thorneycroft. He declared:

"Throughout complex development programs it is essential to cooperate closely with the service customer, but unfortunately this is not made easy under the organization which now exists to procure aircraft and associated equipment for the services.

Referring to the post of Minister of Aviation, Lord Caldecote continued: "The undoubtful advantage of having a cabinet minister responsible both for the procurement of military aircraft and for civil aviation is now seen to be outweighed by the disadvantages of separating the service customer from the supplier and of divided responsibility and the cumbersome machinery created is very far from providing the ideal environment for the British aircraft industry, in modern conditions, to produce aircraft for the competitive market."

Two requirements are vital to produce British aircraft economically, Lord Caldecote said—one is raising money for capital facilities and financing work in progress, at reasonable cost, and the other is competent planning to use available resources in the most economical way.

For both these reasons, he continued, a clear indication of the long term requirements of such a major, and highly valued, customer as the government is of the utmost importance.

Explaining the competitive aspects facing the British aircraft industry today, Lord Caldecote called for a re-evaluation of the present concept of high speed traveling. He noted there has yet to be an overall study of the optimum methods of travel over the whole journey for various stage lengths, saying:

"Such a study may well show that in certain conditions, the aircraft is not at present the optimum method of travel but could be made to be by combining it with the use of monorail cars and other special vehicles.

"Perhaps we need a completely new approach to air travel and to adopt the idea of the 'travel system.' This I would define as being analogous to the weapon system in which all parts are integrated and viewed as a whole. We would, therefore, accept the fact we moved passengers from city center to city center by the optimum means possible."

The approach, according to Lord Caldecote, could possibly lead to a new means of transport and could well have an effect on the design of aircraft increasing the demand for them.

He stressed that in the supersonic era, high speed travel to city centers is a necessity, to keep ground travel times from exceeding time spent in the air.

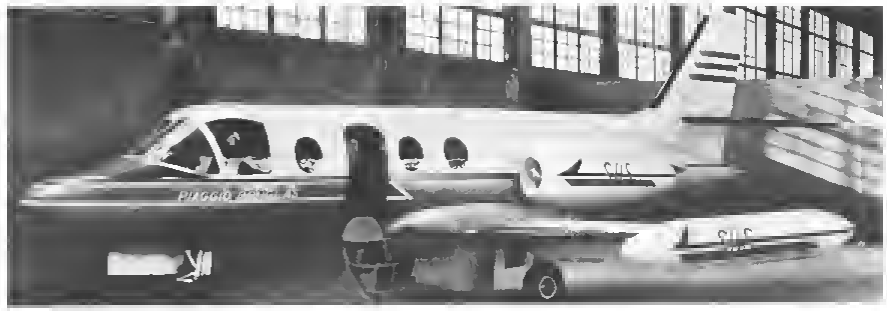
Lord Caldecote, in criticizing the present Ministry of Aviation contracting and procurement practices, said:

On government contracts it is very difficult in practice, however desirable in theory, to give a requirement to a manufacturer and allow him to get on with the job within an agreed sum of money. He must accept investigation and control by many inspectors, administrators, technical cost experts and accountants, whose job it is to impose on him increasingly stringent contract conditions and to ensure that he makes only a fair profit on the work he does.

Such profits as are allowed are based on an out of date formula which barely covers the servicing of the capital employed and leaves no margin for research and development or for balancing the risks taken in civil business."

Lord Caldecote also charged that the manufacturer, during project development, is encouraged by enthusiastic experts from government establishments or the services to include every possible improvement in his product, saying:

"When the cost and time to complete has risen above original estimates (in which contingencies are not normally included) he is criticized first in private and later in the open by the Public Accounts Committee. However, this criticism is not always based on first-hand knowledge of the problems and facts of the case.



Full-Scale Mockup of Piaggio-Douglas PD-808 Shown

Full scale mockup of the Piaggio-Douglas PD 808 Vespa Jet, unveiled recently in Italy, shows configuration of the executive turbojet which has a gross weight of 15,000 lb. and a maximum payload of 2,000 lb. Six to ten place twin jet was designed by Douglas Aircraft Co. with final design, development and manufacture being done at Piaggio's plant at Finale Ligure (AW Oct. 16, p. 73). Engines are General Electric CJ610-1 turbojets of 2,850 lb. thrust each. "Bug-eye" cockpit is designed to increase visibility.

WHO'S WHERE

(Continued from page 19)

Changes

Capt Henry E. Bernstein (USN ret.), manager of product and contractual effectiveness Quantation, Inc., Santa Monica, Calif.

Col John L. Smith (USMC ret.), manager export and licensing, Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif.

C. M. Lewis, marketing manager, Missile and Surface Radar Division, Radio Corp. of America, Moorestown, N. J.

Robert W. Sibel, manager, Los Angeles (Calif.) regional office, Librascope Division of General Precision, Inc.

James W. Roach, director of marketing, Aircraft Missiles Division, Fairchild Stratos Corp., Hagerstown, Md.

Roger W. Honebrink, general manager, Systems Division, Gramm Controls Corp., Duarte, Calif.

N. Elliott Bell, Jr., general manager of program review, and **William G. Martin**, director of performance analysis, Martin Co., Baltimore, Md.

Frank H. Hankins, Jr., technical services manager, Lockheed Aircraft Service, New York, Inc., and **Alvin F. Knoche**, manager, financial services.

Gilbert G. Fleming, factory manager, McDonnell Aircraft Corp., St. Louis, Mo.

W. F. Ferguson, manager of the newly formed Procurement Subdivision, Douglas Aircraft Co.'s Missile and Space Systems Division, Santa Monica, Calif.

James L. Clark, deputy program manager, AN/MPQ-32 weapons locating radar program, Eastern Operation of Sylvania Electronic Systems, Waltham, Mass., and **Loren F. Gaither**, assistant program manager.

Space Technology Laboratories, Inc., Los Angeles, Calif., has announced the following appointments in the newly reorganized Communication Laboratory, Electronics Division: **Richard D. Young**, senior staff engineer; **Lee D. Smith**, manager, Instrumentation Department; and **Harry T. Hayes**, associate manager; **John E. Taber**, manager, Communication Systems Department, and **Phineas Icenbice**, associate manager, **Charles O. Mallinckrodt**, associate manager, Techniques and Components Department; **Roger R. Trapp**, associate manager, Communication Equipment Department.

Fielding G. Lucas, general manager, and **Arnold P. Klimke**, director of engineering, Minneapolis-Honeywell's Ordnance Division, Duarte, Calif.

Robert S. Jacobson, engineering manager, Sperry Gyroscope's Sunnyvale Development Center, Sunnyvale, Calif., and **George Smith**, general services manager.

Kenneth W. Whisler, head of the newly established Customer Services Department, Cessna Aircraft Co., Wichita, Kan.

Thomas H. Sprague, manager of public relations for Aerojet-General Corp.'s Washington, D. C., office, succeeding **Walter G. Winslow**, now manager of public affairs for Aerojet-General Tire & Rubber Co.

Walter B. Powell, director, aviation and government sales, Electric Autolite Co., Toledo, Ohio.

James J. Anderson, production engineer, Hopkins Engineering Co., San Fernando, Calif.

F. Russell Marshall, senior staff scientist, Applied Physics Laboratory, Quantation, Inc., Santa Monica, Calif.

Arnold J. Cogan, assistant to the president, Permacel, New Brunswick, N. J.

Pan American World Airways' Guided Missiles Range Division, Patrick AFB, Fla., has announced the following appointments: **John Potter**, health physicist; **Salvatore Restivo**, chief chemist; **Dr. Peter Ricca**, industrial hygienist.

Dr. Dorr Dougherty, chief, human factors group, Bell Helicopter Co., Ft. Worth, Tex.

H. I. Reynard, director of technical purchasing, Trans World Airlines, Inc.

Horace F. Sykes, budget director, Melpar, Inc., Falls Church, Va.

George A. Norcross, manager, field service and installation, Maryland Division of Litton Systems, Inc., College Park, Md. Also, **Charles H. A. Cochrin**, manager, Navy systems, Litton Systems' Washington, D. C., liaison office.

Dr. Gerald A. Rosselot, director and general manager, Research Laboratories Division of Bendix Corp., Detroit, Mich., and **C. B. Sung**, assistant general manager.

The Mitre Corp., Bedford, Mass., has formed two new departments and announced the following appointments: **Philip R. Vance**, head, Tactical Systems; **Alan J. Roberts**, head, Strategic Systems. Also, **James J. Croke**, head of the company's Sage Systems Design and Test Department.

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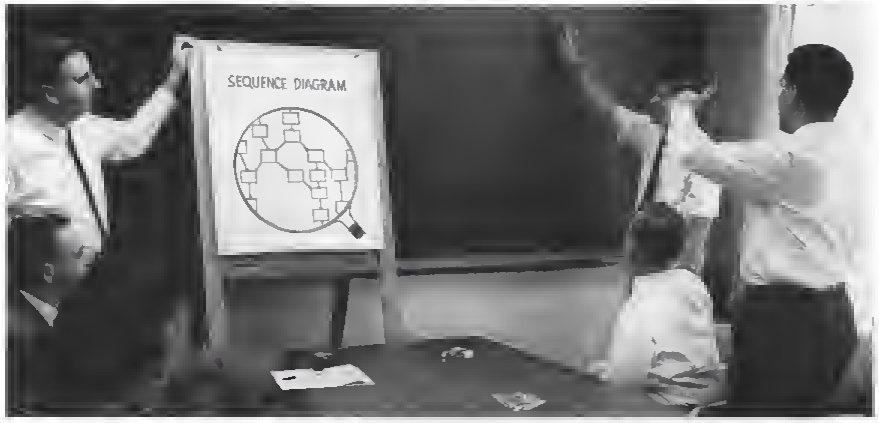

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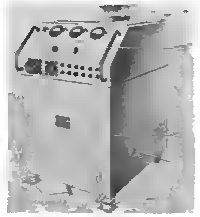

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LETTERS

Airline Insurance

Your timely article, Future of Warsaw Convention in Doubt (AW Jan. 1, p. 26), draws attention to the serious international consequences of U.S. withdrawal from the 1929 Warsaw Convention and Peter Sand's scholarly memorandum reveals the great gap in American implementing legislation. But his suggestion of automatic accident insurance can scarcely be described as a "possible compromise." I have the deepest respect for Mr. Sand's industry and ingenuity, but I fear he may have supplied the cure for a non-existent disease.

Automatic accident insurance is certainly the cure for a scarcity of personal accident coverage, and might even be the remedy for allegations that airlines (or their insurers) failed to pay compensation in the event of accidents to passengers. However, no one, not even the N.A.C.C.A., has suggested that these are the real problems.

The real stumbling block, as you and Mr. Sand have pointed out, is the inadequacy in the U.S.A. of the old Warsaw limit ($8,300) or the new Hague limit ($16,600). No amount of insurance will cure this problem unless it is for sums in excess of those limits. It can't be liability insurance because the liability is limited by Convention—so Mr. Sand suggests accident insurance, which presumably would be the same figure for low income vacationers and busy millionaires. Is there any advance on the present situation? There is no shortage of personal accident coverage.

Why turn the airlines into automatic agencies for personal accident insurance—to the clear delight of the accident insurance industry? Your article did not make it clear that automatic accident insurance compensation would have to be in substitution for liability claims, otherwise the airlines would simply be providing automatic finance for lawsuits against themselves.

If the real problem is low Conventional limits then the only answer must be to raise the limits—at least in the U.S.A. and possibly elsewhere. Fortunately this can be done voluntarily by the carriers, without any change in the Convention or the Protocol and without any legislation whatsoever. Article 22 (1) says:

"... by special contract, the carrier and the passenger may agree to a higher limit of liability."

It may not generally be known in the United States that the United Kingdom has now been authorized by Parliament to ratify the Hague Protocol and in the Commons a proposal to increase the liability limit to £12,000 ($33,600) for non-Warsaw carriage was narrowly defeated by 30 votes to 29. In the House of Lords, Lord Denning (a Law Lord) said:

"Three thousand pounds as at present is far too low, and £6,000, as in the Convention is, I suggest, also too low.

"There is a clause defined in Article 22 which says that by special contract the carrier and the passenger may agree to a higher limit of liability. I should like to see the aircraft companies, by special contract, if need be showing the way to a higher limit of liability."

Mr. Sand commands our deep respect for his review of the situation, but I feel that Lord Denning points the way to a more satisfactory and logical solution for the future. The U.S.A. must ratify the Hague Protocol and the air carriers must seriously consider a revision of their contract terms.

The present IATA Conditions of Contract contain no limit of liability in respect of death—but only in circumstances where the Warsaw Convention or other applicable law does not apply. CAB influence played a significant part in this result. Will the Board repeat its historical role?

(Name withheld by request)
British Lawyer
Richmond
Surrey, England

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Microelectronic Rise

I enjoyed reading your article "Microelectronics Causes Avionics Turmoil" in the May 19 issue (p. 55). Your appraisal of the situation is comprehensive, and you cover very clearly the many problems involved in this fascinating field.

My only area of disagreement involves your projection of "a modest brief market" for discrete microcomponents. Although much depends upon the speed at which integrated circuits mature and the industry masters processes needed to produce them economically for nondigital fields, we feel that discrete microcomponents offer a degree of design flexibility, an adaptability to mechanized microcircuit module assembly for either short runs or high quantities, and an applicability to a wide range of electronic circuitry that may never be matched by integrated circuits.

Our current plans and major selling points in the field of modular microminiaturization can be summarized briefly as follows:

- The Mallory Co. plans to be a major supplier of reliable discrete microcomponents in the pellet and microelement wafer configurations.
- By the application of tried and proven mechanization techniques, we also plan to be a major source for engineered microcircuit modules in both the pellet and micromodule configurations.
- A cornerstone of our program is design flexibility. The customer will retain design control throughout. He will have full choice between purchasing microcomponents and building the modules in his own plant, or purchasing engineered microcircuit modules from a mechanized producer of these modules.
- Both the pellet and micromodule concepts offer the customer a 10-to-1 improvement in size and weight over current printed wiring techniques, plus the ability to make circuit changes with very little cost penalty as compared to the cost of changes required when molecular techniques are utilized. Also, our modular techniques are applicable to a wide range of low and medium powered communications, digital, analog, or control circuitry. Molecular techniques will only be economically practical for low powered digital circuitry for many years to come.
- The micromodule concept offers great potential for the military market during the next few years because much data have been taken to prove its basic reliability. Such proof of performance has not yet been obtained for the pellet concept. We expect also, that our costs will be a great deal less than the cost of equivalent circuitry utilizing molecular or integrated approaches.

S. M. Stuhlbarg, Manager
Microcomponents Department
P. R. Mallory & Co., Inc.
Indianapolis, Ind.

Minuteman Support

Many Bendix-Pacific employes have commented about the fine picture story entitled 'Minuteman Silo Loading Test Launches Shown' which appeared in your Mar. 19 (p. 75) issue on the transporter erector-emplacement system now in use at Vandenberg Air Force Base.

Approximately one year ago the Minuteman emplacement system developed by Bendix-Pacific was demonstrated to the press in North Hollywood, utilizing a special test facility constructed by Bendix to support the development program.

This demonstration used a dummy missile supplied by Boeing, the Cessna missile container, the GMC tractor and rear carriage, and the complete Minuteman emplacement system supplied by Bendix, including (1) the hydraulic power supply, (2) the hydraulic erector actuators, (3) the hydraulically powered mechanical hoist, and (4) the electrically operated sequencing and operating control panel that involves 67 separate steps—such as the raising of the missile positioned within its transport container, lowering the missile into the launch tube, returning the container to the transporter and many safety features.

The employes of Bendix-Pacific are very proud to have played such an important role in the development of this Minuteman system for the Boeing Co. and the Air Force.

As their current role of subcontract supplier of the emplacement system, their disappointment of not having been mentioned by Aviation Week is understandable.

S. R. Craig
Manager
Applications Engineering
The Bendix Corp.
Bendix Pacific Division
North Hollywood, Calif.

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